

Aviation Week

Including Space Technology

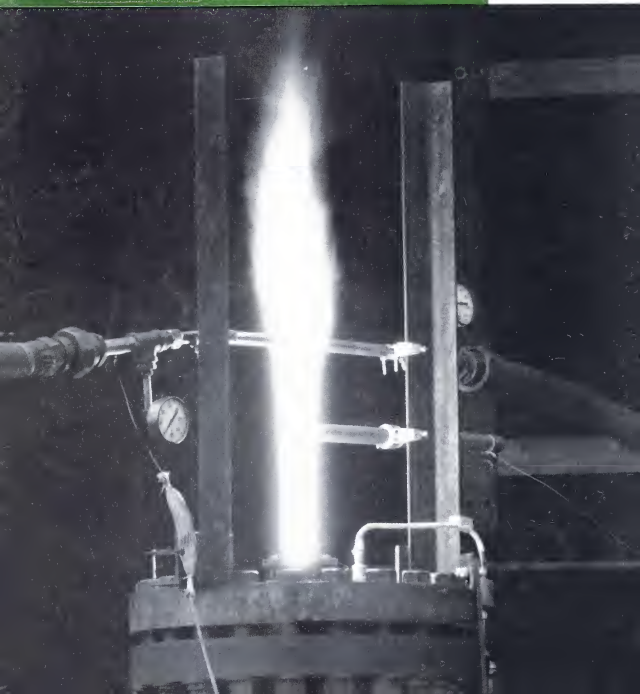
July 28, 1958

NATO Studies
Northrop N-156
Design Concept

General Electric Plasma

75 cents

A McGraw-Hill Publication





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INPUT		OUTPUT				
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Data capacity of operating current on voltage range of 18-30V will be equal to or more than of 80%.		100 VA	15.0	1	78	4
		50 VA	15.0/30.0	0	62	6
		200 VA	15.0/30.0	0	62	12
		1000 VA	15.0	1	62	18
		2000 VA	15.0/30.0	0	65	19

Voltage regulation = 1% Structure Regulation = 0.4-0.6%
Load R. 0.5-1.0 sec. delay current at full load = 2.0 sec.
Voltage regulation 300% of full load
Glows lamp illumination temperature - 30°C - +35°C
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AVIATION CALENDAR

Aug. 5—Regional Technical Meeting on Space Exploration, sponsored by American Rocket Society and the Institute of the Astronautical Sciences. For details: R. D. Linnell, General Chairman, Space Exploration Meeting, 1800 N. Lincoln Drive, San Diego 1, Calif.

Aug. 6-8—Special Technical Conference on Non Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 7th Annual Conference: American Society for Growth Control, Western Branch, 36 Century Hotel, San Diego, Calif.

Aug. 7-9—National Convention, CNY Club of America Hotel Statler, Los Angeles, Calif.

Aug. 775—Modern Developments in First Trade, Chertown Cove, University of Missouri, Missouri, Miss.

Aug. 13-14—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Sponsored by NBS. American Institute of Electrical Engineers and Institute of Radio Engineers.

Aug. 18-15—Seventh Annual Conference,
Industrial Applications of X-ray Analysis,
Alhambra Hotel, Denver, Colo.

Aug. 14-15—North Atlantic Women's International Air Race, Ottawa, Canada to West End, Grand Haven.

Aug. 17-23—Master Operations Research, Engineering Seminar, Pennsylvania State Univ., University Park, Pa.

Aug. 1979—Second Western Regional Meeting, American Astronomical Society, Davidson Auditorium, Stanford University, Box 380, CA 94305.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, 6:30.

(Continued on page 6)

AVIATION WEEK featuring Space Technology

July 20, 1958

Yoshida, S., 1994. *Genetics of Populations*. Blackwell Scientific Publications, Oxford.

1. **Abstract**—This study was designed to determine the effect of a 10-day, 10-hour, intensive course on the knowledge and attitudes of health care workers regarding the management of HIV/AIDS. The course was held in a community health center in a rural area of South Africa. The course was attended by 10 health care workers, including nurses, doctors, and community health workers. The course was designed to provide information on the transmission of HIV, the management of HIV/AIDS, and the role of the health care worker in the management of HIV/AIDS. The course was evaluated using a pre-test and post-test design. The results of the study showed that the course had a significant effect on the knowledge and attitudes of the health care workers. The post-test scores were significantly higher than the pre-test scores for all of the questions. The results of the study suggest that the course was effective in improving the knowledge and attitudes of the health care workers regarding the management of HIV/AIDS.

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Vol. 1, No. 2

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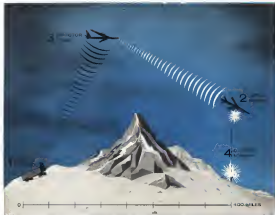
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TRANS-SONICS

Precision Transducers

AVIATION CALENDAR

- (Continued from page 5)
- Aug. 26-27—Third Annual Convention National Flying Club Assn. (Informed Research Hotel Hollywood Calif.)
 - Aug. 29-30—Second Symposium on Naval Hydrodynamics, Washington D. C.
 - Aug. 29-30—North Atlantic Chapter in International Astronautical Federation, Amsterdam, Holland
 - Aug. 31 Sept. 1—Jet-Propelled Race Professional Race Plans Assn. Ft. Wayne Ind. For details, Ohio Airlines 15 Hudson Ave., Akron, Ohio
 - Sept. 1-7—1965 Farnborough Flying Display and Exhibition, Society of British Aeronautical Engineers, Farnborough, Eng.
 - Sept. 1-15—Publication of High Potential Radar Design Summer Program, Massachusetts Institute of Technology, Cambridge, Mass. (Security clearance required)
 - Sept. 3-6, 1965—Cosmos Symposium Conference, Massachusetts Institute of Technology, Cambridge, Mass.
 - Sept. 5-10—First International Congress of the Astronautical Sciences, Palace Hotel Madrid Spain
 - Sept. 9-11—Second National Conference on Applied Meteorology, Engineering Assn. Aeronautics Program Chairman, Dr. D. J. Foran, 2700 East Engineering Bldg., University of Michigan, Ann Arbor, Mich.
 - Sept. 11-13—Annual Business Meeting and Conference, Northeast Chapter, American Assn. of Airport Engineers, Memorial Airport, Worcester, Mass.
 - Sept. 15-18—Fall Meeting, American Rocket Society, Inc. Hotel Seifer, Detroit
 - Sept. 18-19—Second International Astronautical Conference & Exhibit (International), Instrument Society of America, Philadelphia Convention Hall, Philadelphia, Pa.
 - Sept. 22-24—1965 Meeting, Professional Council on Technology and Research, Coast Conference Hotel, San Diego, Calif.
 - Sept. 22-24—1965 Convention of the National Business Aircraft Assn., Seifer Hotel, Philadelphia, Pa.
 - Sept. 25-27—1965 Annual National Western Forum, American Helicopter Society, Anaheim Hotel, Los Angeles, Calif.
 - Sept. 29-30—Air Force Personnel, Casualties and Accidents Symposium, Dallas
 - Sept. 29-30—1965 National Astronautical Meeting, Society of Automotive Engineers Inc., the Waldorf-Astoria, Los Angeles
 - Sept. 29-30, 1965—Annual Meeting and Western Test Show, American Society of Test Engineers, Sheraton Exposition Hall, Los Angeles, Calif.
 - Oct. 1-5—National Aeronautics Conference, University of Oklahoma, Norman, Okla. Co-sponsored by American Assn. of Airport Engineers and the Civil Aeronautics Administration
 - Oct. 7-8—1965 Joint Meeting, Institute of the Astronautical Sciences and Canadian Astronautical Institute, Chateau Laurier, Ottawa, Canada
 - Oct. 22-24—1965 National Vacuum Symposium, San Francisco Drake Hotel, San Francisco, Calif.
 - Oct. 27-28—First Coast Conference on Aero Medical & Navigational Electronics in Atlantic of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.



In action: Sperry system, based on air-transmittable radar (1), can so track track and maneuver drone flight data of up to 1000 ft/sec. (2) Radar display at console (3) shows on-line range or fire distance in seconds. Also in a line of vision of off-axis distance and accuracy of ground-to-air defense (4).

DRY RUN FOR USAF ANTI-MISSILE DEFENSE

New Sperry radar guidance system controls drones at 400-mile range



Automatic control of target drone in flight is directed by operator at console through flight instructions on control console. Man in background monitors missile flight path of drone; drone is tracked continuously on plotting board of upper right.

A microwave command guidance system designed to help test U. S. defense against potential enemy weapons has been successfully demonstrated to the Air Force.

Developed by Sperry under contract with the Air Research and Development Command, the system is scheduled for initial use with Q-4A supersonic drone. It is the first command guidance system to be considered for universal use to control other target drones, provide aircraft and missiles at high and low altitudes and at great distances.

The system tracks a vehicle, determines its engine and flight control, and receives flight data all on a single control link. At extreme range or in mountainous terrain, the system operates through an air director. Like the newer ground control stations, the control aircraft is

equipped with radar maps, tracking, command, plotting and data receiving systems. In addition, dual-sensor optical capability enables long-range drones to be ground-controlled to maximum limits along the range.

That is the basic advance in Sperry's long history in the drone control field. Since 1946 Sperry drone control systems have been applied to every type of aircraft—both reconnaissance and jet.

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watertight hull provides takeoff and landing capability on water, land, and snow. The power plant is a G.E. T-58 gas turbine. The S-62, which will carry 12 passengers, has many advantages for both commercial and military operations.

AROUND THE WORLD WITH SIKORSKY HELICOPTERS



HELICOPTER "SKYHOOK"—The Army has found that disabled light aircraft can be successfully brought back to their home bases by helicopter. Above, an Army HO-4S (Sikorsky S-58) from Fort Hancock, Auburn, Texas, hoists an L-19 damaged in a landing accident at Tucson Municipal Airport, about 300 miles away.



ASSAULT AIRLIFT FOR 6000 MEN—Sikorsky helicopters flew 2500 sorties in a recent amphibious exercise on the Atlantic Coast. Flying from naval vessels, they carried ashore a Marine Corps regiment, 100 vehicles, and hundreds of tons of cargo. Helicopters were RH-53 (S-56) and twin-engined HH-53 (S-56) helicopters, above.



VERSATILE S-55 POURS CONCRETE—A Sikorsky S-55 hovers into position before pouring a 2700-pound load of ready-mixed concrete from its hopper. Helping to build a high-voltage transmission line in California, the S-55 airlifts working crews, as well as batches of concrete for the tower footings, and finally carried sectionalized steel

towers to the inaccessible sites. The S-55 demonstrated the need for a costly construction, road, and airdrop time. S-55s have proved their rugged dependability in a variety of construction jobs, as well as in passenger and cargo transportation. Sikorsky are the only large helicopters fully proved in commercial service.



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When tightened, SEAL-LOCK fittings are triple-locked and dynamically sealed. Left hand safety thread cannot accidentally loosen during installation of hose assembly. Lock not effect prevents loosening by vibration during operation.

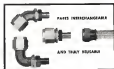
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Aviation Week

Including Space Technology

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U. S. Opposed on ASW Plans for NATO

Requirements were withheld by committee for months. Navy fails to bid to keep competition open.

Pyle Says Jet Noise Still Major Problem

CAR Administrator says no easy solution has been found. NACA being urged to increase its research.

NATO Studies Northrop N-156F Design

Philosophy centers on "blew fighter" test factors and lighter aircraft's changing role in air combat.

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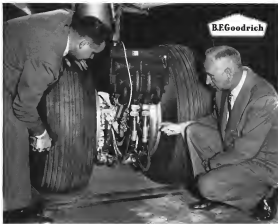
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AVIATION WEEK, July 28, 1958



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EDITORIAL

Von Karman on Space

(No scientist in the free world enjoys a more solid reputation for his achievements in aerodynamics and rocket propulsion than Dr. Theodore von Karman. Nor is any scientist known for a more adventurous spirit in constantly probing the unknown and extending the frontiers of human knowledge in his chosen fields. Because of the courtesy of Dr. von Karman, Aerospace Week is presenting in full his views on the role of the aerospace industry in space exploration as written for "Pilot," the official publication of the Aircraft Industries Assn.—Robert Hottel, editor.)

It is natural that speculation, new scientific ventures should catch the public eye, particularly in the present age to "transcend the space age."

But the success of a few worthy projects in space technology has resulted in some extraordinary conclusions by a number of serious people including scientists, engineers and industrialists.

They seem to believe that most problems in the domain of so-called conventional aircraft or jet engines, which we considered quite important a year ago, are no longer significant.

Extension of Our Activities

There are few voices that have the courage to point out that the new age of space science and technology is essentially an extension of our activities in the same direction that science and technology followed in the last half century.

We like to talk of certain "barriers" to flight. The first was the sound barrier, although there never was a convincing reason why an aircraft should not fly faster than sound, ballistics took for granted 200 years ago that projectiles accelerated to a gun barrel would fly with supersonic speed. Science trailed along behind, in that the ballisticians took the empirical point of view while theoretical aerodynamicists first advanced an under standing of the laws of supersonic flow in the early thirties. To be sure, the theory of supersonic flow in aerodynamics was considerably older.

Two more barriers were supposed to limit speed and altitude, the new barrier to speed was called the "heat barrier," due to the high temperatures developed by air friction at very high flight speeds, the barrier of altitude seemed to be given by the limits of functioning of an operating engine.

Space flight is not limited by either of these barriers. The heat barrier may cause serious difficulties when we want to re-enter the dense atmosphere of our own planet or enter the environments of other planets, moons or stars.

However, this is a transient process, whose duration can be limited, and many solutions are already proposed. The altitude problem requires several developments stretching of the possibilities of air-breathing engines to higher Mach numbers and lower densities.

Then are accepted nowadays, more scientific developments of rockets and "aeronautical" propulsion methods like plasma jets, the exploitation of secondary power sources such as solar energy and electric and electromagnetic fields for particle acceleration.

I do not see any part in these developments which would indicate that:

A. Our aeronautical research institutions, such as the National Advisory Committee for Aeronautics, the university and industrial research laboratories cannot do the basic and exploratory research and the collection of theories and facts, as they did with such evident success in the domain of flight within the atmosphere;

B. The military services should not consider the new activities as a natural extension of their missions and carry out the operations within the framework of their command system;

C. The aeronautical industry should not undertake the design of prototypes and production of standardized items on the same basis as they developed radically new types within the limits of atmospheric flight. I am also convinced that the solution of the new problems will be greatly facilitated by use of the experienced staffs of the companies now engaged in aircraft and engine design and production.

In it, I believe, a natural conclusion that the last way of transcending space projects would be the attention of an agency like the National Advisory Committee for Aeronautics, which presently maintains long experience in administration with far-reaching vision for future developments.

Of course, we aeronautical engineers have to broaden our views and fields of investigation. In addition to thermodynamics, which has always been involved in the problems of high-speed flight and engine design, we have already extended aerodynamics with chemistry for the solution of combustion problems especially in jet engines and rockets.

'Aerothermochemistry'

I suggested the term "aerothermochemistry" for this branch of the aerodynamic sciences, and "aerothermochemistry" has become more and more important because of the chemical changes—dissociation and recombination—occurring in flight at the frontier of the atmosphere. Finally, we have to review and expand our high-school knowledge of astronomy, and perhaps derive from it and thought to a new branch of fluid dynamics "magnetohydrodynamics."

However, those who would say that all that we teach and all that we investigate under the name aerodynamic engineering is obsolete seem to assume that by some miracle the designers of space vehicles will not encounter problems involving such classical sciences as fluid mechanics, structure, materials and electronics. I am sure that this will not be the case.

—Theodore von Karman

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WHO'S WHERE

In the Front Office

Brig. Gen. Albert H. Schwabach, Jr. is now Command Surgeon of Air Force Command in his new department of Air Force and Space Medicine, Los Angeles for Medical Information and Research, Washington, D. C.

F. Y. Shady, A. A. Lonsdale, J. E. F. Smith, board of directors, Bell-Airco, Ltd., England.

Robert L. Dornes, vice president test engineering, Edward D. Gierke, vice president rocket plant, Wilcox E. Carr, vice president-customer relations, Wilcox E. Rogers, vice president-term equipment, John V. Wood, vice president-engineering, Aerojet-General Corp., Azusa, Calif.

Honors and Elections

Air Force Exceptional Order Service Award has been presented to Reed J. Bennett, technical director of Defense Missiles, for "... leading role in development of the Nike intermediate ballistic missile."

First Annual Ray-Warren Trophy for achievement in advancing technology of missiles and rockets has been awarded to Lockheed Aircraft Corp., Sunnyvale, Calif.

Council of the Society of British Aircraft Constructors has elected A. F. Bickel, managing director of the Hawker Siddeley Co., Ltd., president of the Society, and Sir George Dwyer, vice president.

Changes

Capt. George B. Chabot, USN, chief, Plans Office, Aeronautics Administration, Washington, D. C.

Frederick W. Galt, vice president, Aviation Division, United States Lumber Corp., San Francisco, Calif.
Edward K. Newman, general manager, Longwood Division, Thielert Chemical Corp., Merrill, Tex.

Robert E. Dale, acting chief of General Entry Division, Civil Aeronautics Administration, Los Angeles, Calif.

Regina Fels, vice manager, Electro Tec Corp., St. Hartmuth, N. J.

Frank A. Howe, assistant, Washington Office, Thompson Products, Inc., Cleveland, Ohio.

Col. C. V. (Shel) Barrett, retiring at domestic, Detroit, American Communications and manager of Detroit City Airport, Detroit, Mich.

Richard M. Kowalski, Director, Ohio state representative, General Precision Laboratories, Inc., Plainville, N. Y.

Robert W. Rowman, vice president in charge of engineering programs, Aeroquip Corp., Jackson, Mich.

George M. McElroy, coordinator of technical information, Division of Public Affairs, Glenn-Glass Works, Corning, N. Y.

William Q. Nicholson, associate technical director and manager of engineering plans and programs, RMI Electronics, Bang Water Corp., Santa Ana, Calif.

INDUSTRY OBSERVER

►Field gas, steel-type solenoid control system of the kind to be used in the X-15 rocket research plane is being evaluated in a North American F-107A at National Aeronautics Committee High Speed Flight Station, Edwards AFB, Calif. First-level tests in 15-mph jet circuit, self-contained gas is below pilots' seat. Secondary solenoid, now under solenoid control tested on other NACA planes, is individually located. Control solenoid must be controlled under high acceleration, deceleration expected in X-15.

►Reaction jet controls being tested on the Bell X-4B rocket plane are simple on and-off controls, do not have variable thrust as will the system to be used later on North American's X-15 rocket plane. X-4B has jet port only on one wing; pitch and yaw jets are at aft end of fuselage. X-15 has ports on each wing, and pitch and yaw jets are in the nose.

►Thompson Products Ramo-Wooldridge Corp. has begun experiments with small microprocessor simulation models for missiles, spacecraft and ballistic missiles. To demonstrate as microprocessor in some experiments. Companies also is studying reliable rocket ignition techniques in which a small, easily handled plastic bag of red burning wire and is loaded into a cylinder behind the igniter hole. Future studies bag against a spring and pressure and burning wire and wire chamber to initiate combustion in high burning hypersonic combustion.

►Kee 41 is a special alloy developed by General Electric Co. for very high temperature gas turbine service. Material probably is planned for future turbine design.

►Nortronics Division of Northrop Aircraft Inc. has designed a highly sensitive angle of attack sensor for North American Aviation's X-15 high altitude rocket research plane. Sensor is based upon single electric pressure transducer and is currently needed to assist in precise altitude control.

►NACA's five-stage research rocket, which reaches velocity of Mach 16 and above, was preceded by Mach 16 four-stage rockets, Mach 7 three-stage, Mach 5 two-stage and Mach 5 single stage vehicles. Findings are from Piute Research Station, Wallops Island, Va.

►Adding vertical stabilizer on F-107A is headed to those of three degrees on either side of vertical for a shrouded condition on engines for which down. Because center line, this is movable, air flow is required in comparison to relatively small stabilizer tabs that are attached to fixed stabilizers on other aircraft.

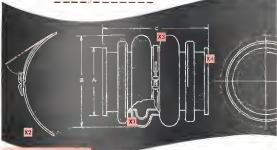
►Infamous rumors in Europe say prospects for Fiat's G-91 lightweight strike fighters are still unimpaired even though France, Italy and Germany want some aircraft for operational use. Germans want pooled order to take advantage of reduced price in quantity, but the interested French parties reportedly are declining. Their order to purchase the Germans to buy Dassault Mirage 3 interceptors.

►North American's four-passenger Suburban UTX jet transport is scheduled to arrive 2,000 lb. Great General Electric J85 engines before Aug. 1. First flight with two J85s now is scheduled for Aug. 20.

►Last two groups of Douglas Thor intermediate range ballistic missile incorporated operational versions of the weapon. Present program is to prove the missile's reliability, gain experience for launching crew. Thor has not yet been fired by a full Air Force crew.

►New Blue Steel air-to-surface missile, which has been down on Avon's Vulture bomber, will be carried completely inside the weapons bay of the Thunder Pan Vulture. Vulture installation means the missile partly out of the bomb bay.

Arrowhead Ducting Design provides Safety Extras!



As an important part of the extra precautions and safety extras, this ducting design performs under compressive stresses at pressures of 30 to 45 psi and a temperature range from -45°F to +400°F with a leak of zero.



FOR THE DOUGLAS DC-8 JET AIRLINER

A unique new "duct within a duct" (patented) and built by Arrowhead performs an extraordinary safety function in the bleed air duct system of the new Douglas DC-8 Jet Airliner. This ducting component provides a "fail safe" device which signals a warning when excessive leakage develops in the inner duct. The outer duct provides operational safety until the inner duct can be serviced.

Constructed of Arrowhead's Aeronut 27 materials, this double duct has withstood such tests to 100,000 pressure and deflection cycles... vibratory accelerations to 15 G's... 100 gpc pressure... and direct flame (2000°F) for 15 minutes.

The remarkable double duct is only one example of the many customer design problems which are solved by Arrowhead every day. Whether your design problems involve configurations... pressure and temperature... resistance to oil and abrasion, the Arrowhead engineering and design group can help you.

For engineering consultation, contact the Field Service Representative in your area or write to the factory direct: Request "Technical Bulletin S-111".

SAFETY X1. Double Duct—A duct within a duct prevents air from escaping safety factor.

SAFETY X3. Fast Seal—Device warns of excessive leakage of inner duct.

SAFETY X5. Aeronut 27—Extreme ultra-high temperature resistant ducting for hot and direct flame.

FEATURE X4. Quick connect—Connects of various types as specified for fast simple replacement.



2330 Corp Street Long Beach, California

Division of
Petersen Metal Works
Beverly Hills, Cal.

Washington Roundup

New ARPA Miff

Defense Department's Advanced Research Projects Agency, part of its prerogative and rolled once again at the Air Force, has dispatched a six-page letter to the Air Force, asking it to submit information specifying that an information on similar contracts under its cognizance is to be released unless it is released by ARPA. Air Force's newest test into the ARPA disclosure was prompted by its release of information concerning planned contracts for the Maestriero intercontinental ballistic missile (see page 21).

Earlier last week from a statement by Lt. Gen. Samuel E. Anderson, head of the Air Research and Development Command, concerning the tentative hearing dates for USAF's latest probe, which are under ARPA's cognizance (AW June 16, p. 20), that they ARPA found Air Force Secretary James H. Douglas is publicly responded Anderson and to declare that his "so-called planning dates" should be wholly disregarded... this despite the fact that the general's dates were consistently correct.

Abolish Patents?

A report by a Senate Judiciary Subcommittee from doing more with patents as a source of "logistics" which no longer serves its purpose of "promoting science and the progress of arts." In a memorandum dated last week, it declares: "The effect of patenting process has been to impede managerial control and commercial progress where, first, unpatented progress is needed to promote the flow of ideas."

It mentions that industrial firms on the other hand, will continue to operate and expand their research facilities in order to serve their particular competitive requirements whether a patent action suits or not. These costs, and efforts, will continue to rely primarily on the scientific research institutions for expansion of the underlying body of science from which technological applications are derived.

Chains of Command

Now have returned the long chain between the people who are responsible for space flight projects and the people on top who finally approve them. But Dr. Fred Singer of Maryland University has given members of the Joint Atomic Energy Committee a special case for page 26. "The Air Side project for a \$400 million rocket, which is a considerable sum, is a good example," Singer testified. "The design was completed three years ago. It took two and a half years to move it to the top."

"The actual doing of it once the contract was let took less than six months."

New Space Committee

House last week approved formation of a new Standing Committee on Science and Astronautics to take over the duties of the Select Committee on Astronautics and Space Exploration. The new committee will be composed of 17 members and will first priorities over all matters relating to science and space exploration. In addition to the new National Astronautics and Space Administration, the Committee will have jurisdiction

over the Bureau of Standards and National Science Foundation, now under the Interagency and Foreign Cooperation and Astronautics Committee. Senate is expected to create a similar committee of 15 members.

NACA Budget Cut

House-Senate conference last week of National Aeronautics Committee for Aeronautics' budget for fiscal 1959 is \$1.2 million, taking cognizance of the fact that the new space agency recently created by the Congress will absorb the NACA's and will require additional funds. The Senate previously voted NACA \$106.5 million, the full amount requested.

The House voted \$105.3 million, the amount accepted in the final conference.

Defense Reorganization

Linked constraints between the President and Congress over reorganization of Defense Department apparently came to an end last week, and conference of House and Senate approved legislation in a brief 20 min session after the Senate in a unanimous 90-0 vote approved a certain growth in line with the vision passed by the House.

The congressional legislation includes provisions as modified from which the President had previously granted (AW June 9, p. 17). These provide for separate departments of the three military departments, for congressional authority over changes in command functions of the services by the Secretary of Defense and for the right of the military, study of staff to appeal to Congress.

Sen. Stuart Symington (D-Mo.) who has been in full accord with the President's plan voted for the measure, but he doesn't think it "goes far enough" from the standpoint of limiting the Department of Defense on progress rather than continuing to have it as an institution.

Federal Aviation Hearings

Hearings on a bill establishing the proposed Federal Aviation Agency were resumed last week in a House subcommittee after being side-tracked in favor of the joint congressional probe of the relationship between president and vice President Adams and Boston terrible plane crash last November. Although the subcommittee was scheduled to conclude hearings after testimony by Shri. James Eastman, D-Wy. Resolved last week, aviation officials are showing increasing concern that the bill on such the House floor too late for action this session. In such an event it would be necessary to introduce new bills in both House of Congress next year which could generate the creation of the independent agency until 1960.

The Senate already has passed the bill (AW July 23, p. 31). One spokesman for the subcommittee suggested that it would be another two weeks before the bill is reported out by the House Commerce Committee and sent to the House floor.

If Congress adjourns by the middle of August, as scheduled target date, the Federal Aviation bill could possibly get lost to the final session to push through last-minute legislation.

—Washington staff

Guidance Changes Made on Atlas, Titan

Webbington-Chapin is being made its guidance system employed on the Atlas and Titan intercontinental ballistic missiles. This includes:

- Atlas, originally slated to use a radio command guidance system developed by General Electric and Bumblebee (AW April 28, p. 74), will eventually employ an all inertial system developed by American North America Corp. (AW May 12, p. 92).

- Titan was designed to use either the firm's all inertial system or a radio-command guidance system being developed by Bell Telephone Laboratories and Rocketdyne Rand Division of Sperry Rand Corp. It now appears that Titan will use radio-command guidance until Ames' production of inertial guidance checks to a point where sufficient inertial system are available to use both Atlas and Titan production schedules.

Reason for the switch from GE/Bumblebee radio-command guidance to Ames' inertial guidance has not been disclosed but appears to stem from different advantages of inertial system other than a reduction in performance of GE/Bumblebee system under operational conditions during engine events. Reason for the changeover not believed to indicate:

- More robust of ICBMs can be launched simultaneously from a base if they employ inertial guidance, but not a radio-command guidance is used.

- Inertial guidance is vulnerable to enemy countermeasures, whereas radio-command system can be jammed. However, extremely sophisticated countermeasures employed in GE's guidance system made it practically impossible to jam, according to company spokesmen (AW June 30, p. 49).

At the start of the Atlas and Titan programs, it was not known whether the state of the inertial art would provide adequate accuracy and reliability in time for either missile. This explains why Atlas was originally scheduled to use radio-command guidance, and an alternative radio-command guidance was developed for Titan.



Three-Engine Powerplant

Test tank, powered Atlas external tank, was fired from Cape Canaveral Fla., on July 19 and was destroyed after a flight lasting two minutes. Cause of the shoot was a malfunctioning control system that produced excessive yawing and pitching motion to break the missile in two.

No attempt had been made to send the Atlas-B on a full range flight. Testing was part of program to test joint capacity of the three engines (see sidebar) plus the separation of the booster engines and the air entry nose cone. Note blunt shape (AW, right).

Atlas missile fired previously were powered only by the two boosters and were limited to a range of approximately 600-800 mi.

Principal changes in the full-powered version of the Atlas, now being produced to test facilities at Convair Division of General Dynamics Corp., San Diego, Calif., are:

- Sustainer engine has been positioned between the two booster engines.

- Staging sequencing of booster engines is completed approximately after first minutes of flight.

- Addition of variable nozzles now come designed to carry nuclear warhead. Also fuel gases, thrust, etc. are regulated from the nozzle and pressure independently to target.

Atlas-B has Rocketdyne sustainer and two boosters but only one propellant tank structure. All stages are staged on ground. All staging boosters are dropped and inertial guidance is built. Sustainer has thrust of 66,000 lb and the boosters have a combined thrust of 316,000 lb (AW May 17, p. 70).

Missile is approximately 90 ft tall and is one year ahead of the USWB's other ICBMs—Marten's two-stage Titan.

To date there have been three successful Atlas launches out of nine attempts. At least one full range flight is scheduled for this fall.

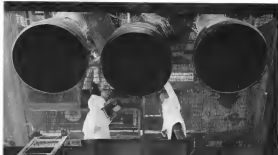


View of Atlas-B (above, left) from overhead shows intercontinental ballistic missile, on its landing stage, being mated into position for erection in test tower at Edwards AFB, Calif. Groundwork below (above), at right of tower, is new fabric of launch pads at Cape Canaveral, Fla. Room carries power and instrumentation lines to test room. First full-powered Atlas-B (above, right) were off course prior to being destroyed. Visualization of inertial system produced sufficient yawing and pitching motion to break missile in two.



Launches Atlas-B ICBM on First Flight

First picture of Atlas-B's engine nozzle shows 60,000 lb thrust sustainer nozzle at center and 165,000 thrust booster nozzles at sides.



Vertol Earnings Sink To 4 Cents Per Share

Vertol Aircraft Corp. earnings sink to 4 cents a share in the second quarter on net earnings of \$22,580. Six months totals for the helicopter company showed sales of \$21,981,251 compared with \$45,332,442 for the same period last year, net earnings of \$185,921 compared with \$1,322,079 and per share earnings of 29 cents compared with 52 1/2.



Vertol's Model 76 Makes First Transition



Vertol Aircraft Corp.'s Model 76 taking VTOL, makes first transitional flight at Philadelphia International Airport. Photo sequence shows position of wing and rotorcraft for takeoff and lift off wing in aircraft's forward nose horizontal flight. Model 76 is first lifting aircraft to go through complete flight transition. Aircraft was developed by U. S. Army, under a contract with the Office of Naval Research and is powered with a Lycoming T53 engine devoted to 600 chp.

Soviet Aviation Show Plays Down Military, Accents Civil Aircraft

Moscow-Soviet Union displayed military and light aircraft at its aviation show during celebration. This was in strong contrast to previous years when the accent normally was on military aircraft.

Only new equipment demonstrated was the "Flying Table," vertical takeoff test bed similar to Bell-Boeing Flying Bedeviler on the Czech Flying Aces Flying Stand or Turbojet (AV Jan 27, p. 38).

Even the Tu 144D, which has been heavily publicized recently for its long distance flights, failed to put in an appearance before the crowd of 240,000 at Tushino Airport.

Transport Mi-6 Flies

Other than the vertical takeoff rig, a fleet of Soviet helicopter and turbo-prop aircraft and of several Yak-24 twin drive rotor helicopters was shown during an air show. This was no static display. This show was the first since the

military show two years ago to which USAF Chief of Staff Gen. Nathan Twining, other foreign observers and Western journalists were invited. Last year's show was cancelled due to weather and a top-level political dispute.

Moscow vertical takeoff rig, making its first public appearance took off from a concrete pad partially hidden from observers by an advertising wall and screen of trees. Vehicle is powered by a single turbojet centrally mounted on a main fuselage with four blades off its control jets on its four legs. Pilot sits 8.10 ft. off the ground on a platform mounted adjacent to engine. The rig represented considerable effort and latest Russian capability although it never at any point lifted very far off the vertical axis.

Many demonstration included vertical climb to about 750 ft. as well as intricate ground-to-air work. One new feature this year was the

participation of satellite pilots and aircraft from Czechoslovakia, Poland, Bulgaria and Rumania.

Eight of the major civil transports consisted of one vehicle, part by each of them at an altitude of approximately 600 ft.

First to put in an appearance was the Tu 134 turbo-prop which initially was shown in low circles at special display. This was followed by a Tu 104A twin jet transport. Then came the Ilyushin Il-18 turbo-prop, tested by the Aeroflot.

Little Bee

Also demonstrated was the Antonov. Little Bee is fast, a twin piston engine airplane designed for short field landing and service.

Light aircraft taking part in formation flying and aerobatic demonstrations included the Tikhonov, single-engine piston, trainer, Czech 270, trainer which has fixed gear, a Russian monoplane trainer called Baker H31 and the Romanov LAR-31 low wing light aircraft.

The helicopter flight also included the Soviet Ka-10 and Ka-15 coastal configurations.



Model 76 with wing in vertical position takes off for first transitional flight. For takeoff and landing wing lifts to a 90 deg. angle for horizontal flight wing is positioned at an angle of 9 deg. Aircraft's wingspan is 28 ft. 11 in.; length of fuselage 34 ft. 5 in. Two auto-propellers and two tail fans are shown in single V31. Tail fans are used for control in the helicopter's forward position, one auto-propeller in control pitch and one placed vertically to control yaw. Altitude during first transitional flight was held to 200 ft. &

Ballistic Missile Group To Advise ARPA

Washington—Ten scientists have been named to work inside Ballistic Missile Defense, Division of Institute of Defense Analysis, to serve as technical consultants to Advanced Research Projects Agency Director Ray W. Johnson and ARPA Chief Scientist Dr. Horst E. York.

Function of the newly formed group headed by William Rindner (AV July 7, p. 30) is to explore advanced techniques and evaluate proposals by individual services on countermeasures for advanced studies in ballistic missile de-

fense area, making recommendations to Johnson and York.

Group will not be directly involved in Army's Nike Zeus anti-missile missile program, nor in Air Force's Ballistic Missile Early Warning System (BMEWS), which are directed toward coming up with solutions to the more immediate ballistic missile threat. In line with ARPA's assigned responsibilities, the new group will seek techniques which can be used to counter more sophisticated ballistic weapons of the future.

Four groups already have been formed within the new group and additional groups will be organized soon. Present groups, their elements and their former company affiliations are as follows:

- Upper atmospheric phases: Dr. Wlad C. Low (Sylvania)
- Very early warning: Dr. David Eick (Radio Corp. of America)
- Intercontinental and special ranges: Dr. Glen Fugger (Lincoln Laboratories)
- Destruction mechanisms: Dr. Wade Huxley (Sylvania Westinghouse)
- Anti-aircraft: Dr. Leroy Tilsen (Bell Telephone Laboratories)
- Active defense: Dr. Richard Holbrook (Rund Corp.)

- Interagency: Clifford Cummings (Jet Propulsion Laboratory)
- Data processing for decision: Steven Hight (Sylvania Corp.)
- Radar: Harry Siddons (GE)

U-2 Grounded

Washington—Air Force has grounded its Lockheed U-2 high altitude aircraft pending results of investigation of two recent crashes in New Mexico within a 24-hour period. National Aeronautics and Space Administration also grounded its U-2s, which it uses for weather research, for a short period but has returned the aircraft to flight status.

Because Air Force grounds made frequent missions of the U-2, especially those assigned to the Strategic Air Command. The Red Air Force newspaper, Krasnaya Zvezda reports to Soviet sources that the U-2 "... has all shortcomings made indicating its mission." The magazine also noted, "... the U-2 has been accepted by U. S. Strategic Air Command (SAC) and has made several flights from the American base at Whiteman, West Germany." The publication suggested that these U-2 flights were for the purpose of strategic reconnaissance.

Pyle Says Jet Noise Still Major Problem

CAA Administrator says no easy solution has been found; NACA being urged to increase its research.

By Robert H. Cook

Washington—Jet noise suppression is still one of the major unsolved problems facing commercial aviation. Civil Aeronautics Administrator James Pyle said last week.

Pyle told the House Legal and Monetary Affairs Subcommittee headed by Rep. John A. Blatnik (D-Minn.) that "no easy solution" has been found to suppress jet noise without seriously affecting the power of the engine. He added that the National Advisory Committee for Aeronautics, "which has been hard at work on the fundamental technical aspects of this problem, is being urged to substantially increase its efforts in this direction."

He said that one engine model, there already has spent over \$5 million and an airplane manufacturer over \$10 million in efforts to develop an effective suppressor.

The Administrator also told the committee, which began hearings last week, as jet transport problems, that there is no industry that recognizes as hard as before the most level of a jet transport is that of a piston-engine aircraft are "appreciable."

He added that "we are not at all sure that can be accomplished with our present knowledge of the problem."

CAA is tracking a number of possible measures to the public, including the use of preferred materials to allow an engine to use titanium and light alloys

which would mean the first number of piston and compressor. Pyle said the use of ducted fan engines could be the next line item should also help. He also told the committee:

- Vortex suppression needs now being perceived have been designed to eliminate many of the difficulties involved with engine equipment.
- Expansion of air traffic make a joint solution of a system of navigational and restriction.

• Federal Aviation Plan next contains provision over Federal Airport Plan. Airborne Vehicle equipment (DME II) has been developed to sell at an estimated cost of \$1,000 to \$6,000 for commercial aircraft, and manufacturers expect to offer models for sale at a price as low as \$1,000. Pyle said that CAA has no immediate plan to make this use of Vortex suppression because of the high cost, but expects to do so around 1967.

Pyle said a workshop to disseminate the use of Vortex will be held in October for the benefit of foreign countries. The International Civil Aviation Organization will discuss Vortex and the use of a common system at its 11th session, meeting in Montreal.

Top heading points for the Federal Aviation Plan is a necessity with CAA studies indicating 75 million thrust engines by 1967 and 115 million thrust engines by 1970. In 1970, Pyle said, "Necessary traffic expansion to cope with this volume means that

Federal aid to airports will have to be more significant," he added.

CAA, which annually issues the National Airport Plan, has contracted with the University of California to conduct a study of commercial air route patterns and passenger potential which will result from the introduction of jet air traffic.

The agency also made a study of the airports where jet air will actually operate, at an end in overall planning and programming of federal funds is related to this study of airports. The study indicated Los Angeles, San Francisco, Seattle, Boston, New York and El Paso were being among the first major terminals to handle jets during 1970.

French Cancel Bilateral

Washington—France has backed out of its bilateral jet transport agreement with the U.S. because of delays in the U.S. Government will be terminated in 42 months since the two countries negotiated the pact before then.

French government emphasized that termination of the agreement had no political implications and that the agreement was being dropped for commercial reasons only.

An F-100 has been described within the bilateral agreement with the U.S. for over a year. The airline said a complete reciprocal exchange of notes with the U.S. and has indicated that An France should be granted rights to serve all U.S. cities which U.S. flag carriers operate into Paris.



Nacelles Repositioned on Production Corvettelle

An F-100's first production Corvettelle has lagged more than 180 in flight certification test program and incorporates several changes, including moving engine nacelles forward to improve center of gravity. Nacelles also have been lengthened and tailpipes of Ball-Kayson Avionics engine have been replaced to reduce asymmetry of single-engine operation. Sud Aviation has extended the wing tip of Corvettelle to house sensors. All F-100s has 34 Corvettelles on order. Royal Air Maroc (Morocco) Airlines has ordered one Corvettelle, but option on another. And has firm orders now for 48 Corvettelles.

F-27 Costs Cause \$5 Million Loss

Hagerstown, Md.—DeLaval, an airplane design company, is helping foreign drawings of the Fokker Friendship to U.S. production (with no credit) in manufacturing engineering and estimating costs and probably will cause F-27's engine and Airplane Corp. to lose money this year.

In a letter to stockholders, Richard S. Buehler, president, said that the company expects a consolidated loss of \$5 million for the last six months and, very probably, some additional losses for the last six months.

The report raised the question of whether the price of the airplane may be raised. No such plan was reported, but the question is under study. F-27's production cost, the price—about \$600,000 for the basic airplane—is now falling in the bargain class.

According to Buehler's letter: "...the responsibility to adapt its production use revised production methods to the Dutch design and design... it ran into unforeseen delays and problems. This involved large expenditures for F-27's engineering and testing, in addition to costs incident to delivery."

Amateur West learned that F-27's encountered problems such as these:

• Dutch drawings were rejected by the Engineering Standards Division. With custom modifications available at relatively low cost, Dutch could not fit the airplane together by hand and needed

less precision in drawings. F-27's also took much time to build previous testing by the U.S. main production which was a weakness of hand work.

• Drawings varied among different stages of the design and finished parts sometimes failed to match. F-27's might have needed for a complete set of one airplane drawings, but there was

Carmichael Designs

Washington—J. R. (Slim) Carmichael, former president of Capital Airlines, is quoted in local newspapers and reports that said "the personal account" after 20 years with the company.

Carmichael was named Capital president in 1947 and broadened a local airline program that pulled the carrier into a possible operation into several years of extreme financial difficulties. He lost the presidency last year after Capital again slipped back into the red.

As a broad acceptance of his resignation, the airline's board reported "deep regret" and paid tribute to Carmichael for his important contribution to the company. Carmichael made no statement as to his future plans.

Carmichael was elected to the position of board chairman last year when former USAP Map Gas Board Robert was elected to replace him as president and chief executive of the company (AW July 29, 1967, p. 39).

designer the airplane would then have appeared too late for American market.

• Conversion of measurements from metric to U.S. system caused additional labor.

• Language barriers hampered communication between the two companies.

F-27's reported a first quarter loss of almost \$2 million, but had predicted a profit by year end. Previously, total F-27's sales were estimated at \$15.2 million. Last year the company wrote-off \$8.7 million of that total.

Sales figures for the F-27 have tended to fluctuate because of the political environment by the prospective buyers, usually local service firms, in carrying funds. F-27's reported prospective buyers for 160 airplanes, but a large share of these are not firm.

Latest report for first sales is 99-12 to U.S. airlines and 18 to foreign. The report seems to approximate the amount specified in F-27's 1957 annual report where F-27's deposits are carried as a current liability under the item of "advances on commercial order contracts."

The figure totaled \$3,175,074. As having a 1958 deposit on each airplane, it would amount for about 58 airplanes.

Wall Street financial specialists say that the future of the F-27 is heavily dependent on the Commercial Loan. Then in, F-27's with eight airplanes and business will see how last year's approval. West Coast Airlines is preparing to take delivery on the first order F-27's ordered, but is of new has obtained no Commercial Loan.



Boeing 707 Makes Automatic Landing

Boeing 707 prototype made three successful automatic landings recently at Boeing Field, Seattle, using AN/CSN-1 system developed by Bell Aircraft Corp. a Western Division, St. Louis and Air Force (AW May 1967, p. 32). System enables ground rules to determine wind direction and speed data late to transmit from and cause conversion to control instruments and automatic pilot. Prototype system will be evaluated in 1968 by Texas Instruments based at its Atlanta City facility.

Board Proposes Pilot-Trained Engineers

By L. L. Doty

Washington—An ongoing presidential feud reignited to fly and settle the bitter controversy between airline pilots and flight engineers over crew complement was compounded last week that third crew members on turbojet transports increase pilot qualified.

Although the board's proposals are not legally binding on any party, such recommendations are seldom ignored and are expected to add a further twist before negotiations by U.S. carriers. Under the board's recommendations, based on a dispute involving Eastern Air Lines, flight engineers would continue to serve as "pilot-qualified" and turbojet equipment without flight training and would be given an opportunity to qualify as pilots if assigned to turboprops.

For long-standing feud between the Air Line Pilots Assn. and Flight Engineers International Assn. on the third crew member issue has threatened a strike in the introduction of jet operations into scheduled service by U.S. carriers.

Why the Dispute

In outlining its position for eliminating the engineer's position on turbojet aircraft, the board found that flight engineers and pilots will introduce additional problems of a piloting nature while continuing those of the mechanical nature.

It is said that what the pilots fear is someone who can relieve them of some of their nonmechanical but important flying duties, with the purpose of not only making their workload more intensive but, more important, of promoting safety.

The time that came to a head in 1958 when the pilots union announced its decision to demand that all crew members on turbojet aircraft be pilot-qualified in pilots (AW Nov. 24, 1958; p. 34). Since then, the engineers have conducted a heated campaign to retain their status on the cockpit.

During the last year, the engineers have successfully agreed contracts with Pan American, American and TWA. Would extending their job rights into jet operations. The contracts increasingly drew a warning from the pilots that no jet transports would be flown by ALPA members or pilots. In these pilots are assigned to each aircraft with an without flight engineers (AW March 31, p. 34).

The board's report, which has been accepted by President Eisenhower, does not constitute a settlement of the strike threats against Eastern. In January,

both unions voted to strike but eastern was delayed by the outcome of the emergency board through executive order of the President.

Now, both unions are expected to negotiate with Eastern during the next 10 days after which time the board is expected to issue its report.

The board's report is considered by most observers as a victory for the pilots union. However, ALPA President, C. N. Sevens, and Chicago said the report calls for comprehensive study before determining the union's position on the recommendations. Sevens did imply some satisfaction with the report by adding that it also examines the recommendations of the President of the U.S. and, therefore, carries great weight and must be carefully considered.

Engineer Opposition

George R. Pein Jr., president of the flight engineers, strongly rejected the report by stating that it will accept no findings on the crew composition used by the board. "It branded the report 'unreasonable and foolish'."

There is no doubt that the board's decision on a sharp blow to the flight engineer's union. The union has been strengthening its position for several years to meet the anticipated decline in employment during the initial stages of jet transport operation.

Whether it will survive this attack will depend entirely upon its success in future negotiations with the airlines. Civil Aeronautics Board regulations governing flight engineer requirements permit either pilot-qualified or mechanically-qualified engineers to be the first engineer in a crew. Qualification requirements are to be revised periodically.

According to the emergency board report, Eastern officially maintained a "hands-off, neutral policy." With this compromise, the carrier took its position over the results of mechanical crew pilot-qualified flight engineers, according to the board.

Some observers feel there is a strong chance that the engineers union, as a result of the board's decision, will join the AFL-CIO, of which ALPA is also an affiliate, to James H. Doolittle's International Brotherhood of Transport which recently announced it would try and merge labor within the transportation field.

Such a move would be the result of an earlier recommendation by the AFL-CIO that the Flight Engineers International Assn. merge with the Air Line Pilots Assn. so that the flight crew would be pilot-qualified with one organization. ALPA has accepted this recommendation but TEA has rejected it, not

wishing to lose its identity as a bargaining agent for the engineers.

In no way did the board spell an end to TEA. One of its recommendations was that the flight engineers, acting through their union, carry into effect some "agreement" with ALPA members for the purpose of reaching an agreement on their respective contract security provisions. It urged that the two unions "jointly" approach Eastern and discuss working out the necessary revisions of these provisions.

The board stated that TEA's line of contention is "not unique" and added that other small issues have formed out of safeguarding their interests to remain adequate representation on governing bodies and negotiating committees.

The board's recommendations suggest that flight engineers who serve on turbojet aircraft be required to qualify in pilots in the cockpit, holding a crew manual license and an instrument rating so that they would be capable of doing and landing the aircraft in case of emergency.

Flight engineers serving on pilot-crew aircraft will be required to meet pilot requirements to do so without meeting pilot requirements.

Who Pays

The report said that "the flight engineer taking such pilot training will presumably do so on his own time but through at company expense." It added that if the engineer chosen to be trained as a pilot, his salary on the engineer fee should continue to accrue for sufficient time to insure him job protection.

The board placed primary consideration on an air and land cost that better depicts the relation between the pilots and engineers union engaged upon the safety issue. It pointed out that the friction and antagonism between the two organizations has grown in a result of the crew complement issue.

The board emphasized that the role of flight engineers is that of assistant to the pilot and that the responsibility for the aircraft will be shared with the captain. It noted that safety statistics brought by the Civil Aeronautics Board in 1948 when the flight engineer requirement was established has been substantially achieved with other pilot-qualified or mechanically-qualified engineers.

It added, however, that the friction between the two unions has a tendency to provide that degree of cooperation which is required to operate an aircraft and that of flying airplanes in the air transportation industry.

Two boards were established by the

President, one to handle the ALPA issue and one the TEA issue. However, both boards were composed of the same members. The one on the L. C. C. chairman, Sam Waller and DuBois E. Whiting. All three have a long record of negotiating labor disputes.

The board met several times in January and continued in New York on Feb. 15. The board requested and received from the President five 70-day extensions of the time specified in the executive order for the board to make its final report.

The board reported that it met with the parties jointly and separately in an effort to bring about settlement of the conclusion of hearings but added "their efforts were not completely successful."

SHORTLINES

► **Condor Luftverkehrs GmbH**, a West German charter airline, has purchased two Boeing 707-320 turbojets from Condor Flugdienst, Hamburg, without flying as an independent charter airline last month serving European travelers en route to Mediterranean and other tourist centers.

► **The Flying Tiger Line** reports that air freight revenues for the first half of 1958 were 10% higher than those for the same period of last year. Revenues of \$5,275,567 were reported as compared to \$4,758,375 for the first half of 1957. Total air freight revenues were \$901,188, a gain of 24% over the first, 1957, revenues of \$731,399.

► **Kod-Brands International Airlines** has transferred its U.S. headquarters from Miami to Chicago. In announcing the change, Captain Loren Covey, first president, cited the "growth of both passenger and cargo traffic between Chicago and the expanding markets of South America" as the reason behind the transfer.

► **TSA-Transcontinental S. A.**, independent Argentine airline, is scheduled to begin international operations in mid-August with service between New York, Caracas, Rio de Janeiro, San Paulo and Buenos Aires. TSA will operate on a three flights per week schedule using Lockheed Super 31 Constellation aircraft. The airline has on order a 520-airframe fleet of Constair 600 jet airplanes scheduled for delivery in 1960.

► **SAS, Scandinavian Airlines System**, reports that it carried 25,920 lbs. of air freight on its polar route from Los Angeles to Toronto ports during January approximately a 20% increase over the previous monthly record.

AIRLINE OBSERVER

► **Airline carriers** which based on the New York Stock Exchange continued to hold close to 1958 highs last week, although some given full effect of those registered by the market generally. Strength of airline stocks was anchored by some factors as a result of action to heavy buying of leading indicators stocks following recent reports of possible business developments and strong stock operations.

► **American Airlines** has determined that descent of its 707 jet transports should begin about 120 minutes before the airport when no holding is involved. Descent rate of descent for landing at maximum gross weight should be 1,000 ft. per minute at 300 knots indicated, slowed down to 10,000 ft. to 20,000 ft. Therefore, descent should be about 2,500 ft. at an indicated speed of 135 knots.

► **Available seat miles** offered by the domestic airlines in 1958 totaled 314 billion, an all time high. However, percentage of increase during the first six months of last year was only 1.7%, the lowest rate of increase in this category recorded in recent years.

► **Lockheed Aircraft Service International, Inc.**, representatives are discussing with Mexican government officials a basic aviation program that may involve the construction of the first complete transport overhaul base in Latin America.

► **North Central Airlines** has agreed an agreement with Continental Air Lines for the purchase of five Constair 340 aircraft with delivery to begin in January. North Central plans to use 53 airplanes for the fleet through the role of replacement for retirements. An additional 52 aircraft working capital lease is being worked out with Northeastern National Bank of Minneapolis and the Irving Trust Co. of New York.

► **Chicago Helicopter Airways** is drawing close to its goal of carrying 300,000 passengers this year. During the first six months of 1958, the airline carried 47,862 passengers in comparison with 14,471 for the same period last year.

► **East Coast's** only jet transport plane, the Boeing B712 (AW May 26 p. 42), is scheduled to begin flight tests in August.

► **American Airlines** is conducting a six-stage training program for Boeing 707 jet transport pilots. The program, requiring a total cost of approximately \$2.5 million, includes a basic pilot indoctrination course, ground school, flight simulator, in-flight training, company sponsored training and final scheduled flights with clearance.

► **Napoli Airways** one of Britain's independent airlines, will cease operations Sept. 30. The company, a subsidiary of Peninsular and Oriental Steam Navigation Co., has opened Sited flying routes between Britain and Lisbon and Madrid.

► **KLM Royal Dutch Airlines** and the Soviet airline, Aeroflot, last week began direct weekly service between Moscow and Amsterdam under the terms of a recently signed bilateral agreement between Russia and the Netherlands.

► **Civil Aeronautics Board** last week authorized Continental Airlines to fly between Dallas-Fort Worth and Midland, Odessa, Abilene, Amarillo, Lubbock, El Paso, Albuquerque and Santa Fe. Texas Texas was authorized to fly between Dallas-Fort Worth and San Angelo, Texas. The authorizations were voted tentatively in the Dallas to the West Coast Case.

► **Air Traffic Conference** decision to eliminate the \$3.00 penalty clause of the newboard contract plan on August 12 and to drop the reformation ruling on Dec. 1 has been approved by the Civil Aeronautics Board. Changes are now being made by the conference will agree to a narrow program similar to contract to American Airlines' verification plan (AW Feb. 31, p. 29).

Airline Traffic—May, 1958

	Revenue Passenger Miles (RPM)	Revenue Passenger Miles (RPM)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-miles	% Revenue Ton-miles
DOMESTIC TRAFFIC								
American	612,000	111,771	42.0	1,751,799	742,399	7,891,099	10,385,697	32.7
Boeing	674,900	70,720	38.4	316,801	108,921	372,760	8,201,472	40.9
Capital	337,183	11,561	39.8	141,000	276,700	348,140	16,488,790	39.0
Continental	44,372	37,700	44.8	109,152	61,089	183,244	5,211,779	37.0
Delta	838,680	100,101	34.0	416,214	342,884	1,019,620	12,398,463	38.0
Eastern	811,292	391,179	49.39	546,316	426,344	1,142,660	10,400,194	15.16
Northwest	327,580	44,400	31.7	363,448	10,204	7,384,179	9,858,119	48.3
Northwest	67,409	37,463	41.9	46,324	28,734	89,800	3,819,623	10.3
Southwest	134,191	56,702	46.5	466,581	212,656	647,499	9,893,190	40.0
Texas Eastern	363,193	368,201	66.9	1,191,338	347,487	2,379,866	35,761,873	33.3
United	361,180	461,649	61.9	2,044,208	854,212	4,189,230	47,330,812	10.3
Western	208	10	25.0	—	—	5,478	—	48.3
INTERNATIONAL								
American	3,421	7,142	34.7	4,799	970	504,120	1,844,978	44.8
Boeing	3,473	4,482	42.0	11,820	—	84,465	841,493	39.3
Continental	11,111	1,959	33.6	1,076	—	3,083	133,423	10.0
Delta	4,548	2,784	47.5	7,187	—	10,710	764,938	10.1
Eastern	30,287	37,664	46.28	88,708	—	88,460	4,099,707	47.31
Northwest	4,212	1,108	34.0	—	—	1,118	134,946	12.9
Southwest	1,024	2,208	38.0	—	4,344	10,344	404,944	16.4
United	12,068	31,770	30.8	1,104,179	17,341	723,434	4,391,769	47.0
Western	—	—	—	—	—	—	—	—
For American	3,421	4,179	42.0	30,819	—	118,356	619,541	57.4
Boeing	106,160	142,367	58.1	1,304,483	—	3,154,190	16,240,824	29.3
Delta	70,977	67,490	58.0	290,400	—	4,204,587	10,801,781	58.4
Eastern	30,148	71,324	60.0	1,084,261	—	1,610,187	10,918,269	44.9
Northwest	10,212	11,484	33.0	20,493	—	428,293	2,410,893	19.9
Southwest	—	—	—	—	—	3,779,147	5,791,587	77.3
United	18,707	1,814	34.7	769	—	8,440	180,801	54.8
Western	29,194	60,060	61.0	862,180	—	429,241	9,474,723	39.3
WORLD:								
United	7,440	13,866	46.0	142,484	—	81,698	2,160,960	48.0
Western	247	384	48.0	—	—	47,289	18,000	48.0
LOCAL SERVICE								
Airway	28,472	4,994	46.7	9,738	17,231	17,340	761,763	40.4
Boeing	14,540	2,774	44.4	4,419	2,846	8,811	371,469	39.4
Continental	11,193	5,187	34.1	4,903	2,187	7,189	316,438	39.4
Delta	14,820	2,107	38.4	3,884	18,018	—	334,548	18.4
Eastern	39,056	2,369	63.0	4,476	14,720	12,495	791,267	40.4
Northwest	60,620	10,106	44.4	31,861	30,438	—	1,524,990	40.1
Southwest	21,094	2,389	42.7	10,769	15,076	—	410,404	40.4
United	33,184	7,240	46.8	71,222	3,960	9,436	714,797	59.4
Western	19,049	10,416	54.0	14,108	6,430	—	714,438	40.8
World	17,128	3,200	36.0	8,507	4,963	8,420	336,723	36.0
World-Texas	15,011	4,371	38.1	11,703	7,990	30,444	487,341	37.1
World-South	32,180	3,414	48.37	4,900	5,700	8,780	381,191	40.4
NAVIGATION								
Boeing	39,713	4,568	48.0	2,844	—	122,492	448,446	51.9
World-Pacific	—	—	—	—	—	—	—	—
CASCO LINE								
AARCO	3,138	10,842	—	1,472,100	3,498,591	—	—	40.49
American	—	—	—	—	—	387,797	—	83.3
Boeing	—	—	—	—	—	—	—	—
Continental	—	—	—	—	—	—	—	—
Delta	—	—	—	—	—	—	—	—
Eastern	—	—	—	—	—	—	—	—
Northwest	—	—	—	—	—	—	—	—
Southwest	—	—	—	—	—	—	—	—
United	—	—	—	—	—	—	—	—
Western	—	—	—	—	—	—	—	—
HELICOPTER LINE								
Chicago Helicopter	5,748	181	46.0	1,727	—	—	18,866	38.4
Los Angeles Helicopter	3,417	100	29.0	4,971	1,415	—	18,957	29.0
New York Airways	5,096	119	46.0	1,423	799	488	16,434	47.0
ALASKA LINE								
Alaska Air Lines	3,320	2,960	54.0	30,209	—	267,648	448,906	48.3
Alaska Central	83,194	4,714	63.0	47,799	—	30,426	379,810	59.0
Boeing	1,414	107	34.4	4,327	—	9,709	97,266	41.9
Continental	4,440	107	61.0	1,723	—	2,016	38,349	70.0
Delta	1,294	103	42.3	27,237	—	47,097	138,440	33.0
Northwest	8,077	9,028	60.0	60,203	4,427	267,648	1,380,488	68.8
Southwest	1,716	770	31.3	20,794	—	12,047	179,820	54.0
United	1,191	740	35.0	27,841	—	212,091	385,448	48.0

* Not available. † Western cities 2/1/58 to 4/1/58. ‡ U.S. cities, Mexico & Central America. Compiled by AVIATION WEEK from carrier reports to the Civil Aeronautics Board.

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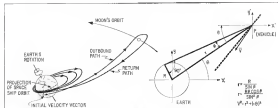


Helping Hand for the Navy's Air Arm — Kaman HU2K-1

The most delicate job in the free world is entrusted to the men of the United States Navy. They must demonstrate to those who would extend the iron curtain that we have not mottolled preparedness. They must also teach the kids in the shadow of the iron curtain that fists clenched in defiance can also hold a baseball. Much of this assignment falls to Naval Aviation which maintains an endless global vigil, yet stands ready to rescue and evacuate injured. On these important missions Kaman utility helicopters extend a helping hand to the Navy's Air Arm.

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SPACE TECHNOLOGY



MAKING a close approach to acceptance of a one-dimensional grade. (WADC) tests weight of extra-market fuel but requires precise knowledge of velocity vector. Techniques for measuring vector and direction (right) by optical and computer means has been proposed by WADC.

WADC Explores Lunar Probe Control

Dartmouth-Naval technique for determining velocity vector magnitude and direction of a one-dimensional grade. (WADC) tests weight of extra-market fuel but requires precise knowledge of velocity vector.

Wright Air Development Center's Flight Control Laboratory, engineers headed by George Nussli, also point up one of the precision control problems in related to recovery of a lunar probe vehicle in terms of a heading change, approach to which the vehicle slowly spirals into a circular orbit as a result of atmospheric drag.

Heading change approach requires extensive precise control of the vehicle equation angle or velocity at launch as well as injection altitude as the vehicle enters the earth's atmosphere as it returns to Earth. However, the technique is known with low fuel burn, for lunar vehicle gross weight (less fuel) of some 10,000 to 15,000 lbs. (less fuel) of some 10,000 to 15,000 lbs.

Precision Return

For example, assuming that initial heading change vector for a 15,000 lb. payload can be controlled to within 0.001 deg. at 10 ft. WADC's analysis indicates that approach, 100 ft. of fuel would be required to correct for space disturbances encountered on entry, and could bring a vehicle back with acceptable precision to permit heading change approach.

In contrast, use of extra-market fuel to slow down a vehicle from 10,000 ft. to an entering speed of 25,000 ft. would require an estimated 10,000 ft. of fuel.

Further, the authors indicate that the heading change and approach profile to corresponding axes in the space vehicle. Heading change between vehicle and earth's center is:

Where r is radial distance, R is earth's radius (assuming spherical earth).

θ is angle defined in plane containing vehicle and earth's center.

Radial component of vehicle's velocity is:

Also, similarly, tangential component

Where X and Y is assumed to be constant at the heading change and approach profile to corresponding axes in the space vehicle.

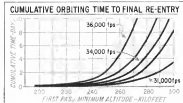
Heading change between vehicle and earth's center is:

Where r is radial distance, R is earth's radius (assuming spherical earth).

θ is angle defined in plane containing vehicle and earth's center.

Radial component of vehicle's velocity is:

Also, similarly, tangential component



RECAPTURE orbiting time using lunar ellipse is shown as function of launch altitude.



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Interior of the new French Air Force centrifuge room showing centrifuges equipped with Avionics pods.

New French Centrifuge Has 15G Initial Acceleration

Strasbourg, France—French Air Force Parastatistical Research Center has begun space flight research using a high-speed centrifuge as a test piece of equipment.

Centrifuge is said to be capable of 15G radial acceleration and a maximum of 40G by using a cluster when one and two inertial accelerations require consists of a piston driven by compressed air which surrounds a cubic stepped second hole of centrifuge vertical axis. Avionics reports a high initial acceleration and ground station then engages for higher accelerated motion. Power is furnished by a 455 kw motor that turns a 195 ft arm up to 77 rpm at approximately 110 mph. Total weight of arm is about 11 tons with a 716 lb counterweight.

Unlike the U.S. Navy's Johnsons, Pa., centrifuge (AW 34, p. 38), the French pilot gondola does not have a hydrostatic system to overcome subject's motion response. Control room for the centrifuge is located between the roof and the upper end of the vertical axis. Lateral movement in the center of the control room from its measurement room. Interior of control room contains surveillance television, portable and non-cyclic communication equipment, visual response light panel and theograph for centrifuge position.

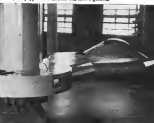
Centrifuge arm accommodates a TV relay station and a locked rod that slings in two different gondolas: one for normal and control studies and the other for human subjects. Letter can be positioned so its roll rate to station negative or positive gravity force. Later change of gondola is accomplished through one of its vertical electrically driven least controlled from ground level.



Large area in upper left of gondola is visual response light panel.



TV set monitors subject during tests (below). Centrifuge arm (below) is equipped with manual and control gondolas.



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Airborne, the Hercules climbs 2,650 feet per minute, fully loaded, and cruises at 305 knots. Arriving at its destination, this prop-jet giant can land and stop within 1,500 feet—saving extra minutes of precious time. Highly maneuverable, it can be positioned quickly for unloading. Attach the winch cable, press a button—and out glides the whole 35,000-pound cargo in 40 seconds! If you haven't yet heard all the facts about the time-and-dollar-saving capabilities* of the Hercules Jet Age airlifter, please write or wire:

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*The 4-engine tail loading/unloading system available only with the Lockheed Hercules makes possible a 60% savings in manpower required to prepare and load

freight for air shipment. And a 50% reduction of life ground time can be accomplished by shortening the unloading/ loading period from hours to minutes.



MISSILE ENGINEERING

On-Site Loading Proposed for Big Solids

By Michael Yaffe

Huntsville, Ala.—Taking a cue from established liquid propellant procedures, Thiokol Chemical Corp. is proposing on-site loading as a solution to the problem of transporting very large, and heavy solid propellant cylinders. The suggestion was recently set before the Defense Department in detail.

Although the problem does not actually crop up, most, until recently and legislators are convinced that now is the time to start working about possible solutions. The first 10,000-lb solid propellant engine has already been built and static fired. Serious thought is being given to a solid propellant missile weighing several hundred thousand pounds and more than 100 ft long—certainly too big for ordinary used truck trailers and means of transportation.

To get around this difficulty, William J. Harby, chief of present development at Thiokol's Redstone Division, has developed plans for a mobile propellant loading plant. Like today's large liquid propellant rockets, the solid propellant missile would be carried unloaded and if need be, disassembled in the launch area where it would be canted in place and then loaded with precast solid propellant.

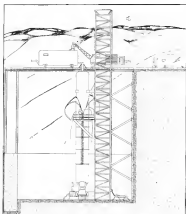
Site Problems

Assembly and erection of the complete missile can be carried out with techniques now used in the construction of large tanks and will present no problem according to Harby. The selection of suitable launching sites, on the other hand, could prove difficult.

Successful operations hinge on launch on firing areas to the top of the cylinder, eight-mile clock, several hundred feet high. Setting up a conventional launching complex, this large would undoubtedly prove difficult and expensive. One way out is through the selection of locations that are partially surrounded by sheer cliffs of the required height.

Another and more likely solution is the use of abandoned waste dumps or pits specially prepared.

Once the missile, using its re-plan, lands on firm, solid arms, carrying the propellant is possible. Unloading containers. Prepared at some manufacturing plant, the propellant must be in the form of paste or slurry, contain no bulk oxidizer and fuel elements. A mobile crane would lift the containers from the transport carrier and dump



MOBILITY is key to proposed system for on-site loading of solid propellant missiles weighing up to several hundred thousand pounds. Apparatus shown are for mobile units, two specialized engines in the rear, come across propellant from truck to launch site where it is mixed with catalyst and then pumped into top of missile. The winch on the pump (below) is being on the heavy blanket which is used in caving the propellant.





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them into a mobile blending unit. In the process, the blander must be a dual mode unit where one batch is blending and discharging while the second is being poured. If required, more than one blander could be used. A mobile unit would supply the power required to operate the blander and to maintain temperature control. The unit also carries the catalyst used to set up the finished propellant.

In the blander, the premixed propellant mixture would be mixed with the catalyst, stirred and then fired propellant into the top of the nozzle. The propellant would start to set soon after entering the nozzle throat. A heating blanket, wrapped around the casting collar, would be used in the curing and finishing of the cast grain.

After final inspection, the grains could be inserted, the top cap welded on and the nozzle would be ready to go. The whole operation would take from a few hours to several days, depending upon the size of the nozzle and would be largely automatic. The job finished, the mobile unit could move on to another site.

In the case of a multi-stage nozzle, the operation would be essentially the same, except that after the first unit is loaded, the second stage is dropped into the shell and attached in place at the cap.

The process is then repeated as many times as there are stages. Although the system was developed primarily for large single stage units, it would work as well for multi-staged, smaller or smaller single stage vehicles.

The mobility of the system also gives

Five-Stage Rocket Firing

Extensive foreign rocket development of all the jet engines have been fired at speeds above Mach 15 and in attitudes of several hundred miles in altitude on smaller and specialist. National Advisory Committee for Aeronautics reported.

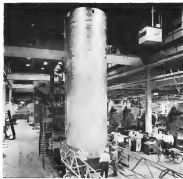
Five-stage rocket consists of an H-bomb, two Nike boosters, a Rocket and a T-55 and an extension of a variable length stage. The NACA in 1945. Experimental boost phase rocket engines are considered by firing the last three stages in rapid succession just after the power peak trajectory.

Similar rocket could have and using the same five stages, is being used in Operation Hardhead to measure radiation patterns and other effects of cosmic atmosphere nuclear blasts (XW July 7, p. 26). NACA version is 35 ft long, weighs 3,800 lb and carries 18 ft payload. Five-stage boost phase Launch Acceleration Laboratory's (Pittsburgh, Pa.) Rocket Station, Walling Island, Va.



Parallel Missile Production Lines

Jupiter and Redstone ballistic missiles are in production on parallel lines (above) at Chrysler-operated U. S. Army Motors Missile Plant near Detroit. Jupiter boosters shown in (below) magazine in plant lot. Heavy presses can be seen in background.



at the advantage in solid compared with a large fluid unit propellant loading plant which would be more vulnerable to bombings or sabotage. If the mobile unit were loaded into the stage up to the overall motion effort would be less. On the other hand, motion effort would be less when solid propellant units with unattended ground support equipment even though it is not a short time. Balance lot of such equipment has long been an advantage, not in the solid propellant advantages.

This is strictly a production type of problem that would undoubtedly take place in plant, the solid advantage re-

ally, and once the nozzle is loaded it is in the same state as a cast solid propellant vehicle, unattended by propellant support units and with no need for maintenance.

In an event that is considered of secondary importance, The important thing is that when solid vehicles get this big and main engines are considered this more so, they cannot be handled by conventional means.

Various details of this proposal suggest its application to the Vanguard project. Used to date, an air loading is still a theoretical project with no government support.

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During the next few months the Army's Iroquois helicopter — the Bell HU-1A — will be put through a series of stringent, exacting tests. A 6 to 8-place, turbine-powered utility helicopter, the Iroquois was built expressly for front line duty with the Army.

One of the obstacles the Iroquois must run is the U. S. Army Transportation Aircraft Test and Support Activity 1000 hour logistical evaluation test. TATSA has developed an accelerated 1000 hour test program that must be completed in no longer than six months. The Iroquois will be flown a minimum of 10 hours each day — maintenance and upkeep must be done at night. Simultaneously other testing agencies will expose the Iroquois to every possible operating condition that may be encountered later by using units in the field.

One of the chief benefits from this testing is the tremendous savings to the government in providing the services with a tried and tested aircraft, fully capable of meeting all requirements for which it was procured. The Iroquois has already passed Bell's own exacting tests — proved its worth as a warrior. Completion of Army testing will insure that the U. S. Army has in the Iroquois today's best and most advanced helicopter.

U.S. ARMY'S TATSA PUTS THE IROQUOIS TO THE TEST!

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OVERHEAD crane built in the Fort Worth International facility, which, across the high bay area is factor area of Comsat Aerospace test facility near plant at San Diego. Giff. Picture was taken while installation of today's test under way.

Astronautics Plant Gears to Space Role

San Diego—Astronautics Division of Comsat dedicated its new Keesen-Nixon facility recently, a \$40 million establishment designed and gained to transportation and production of high-precision, low-altitude missile and the space vehicles which will follow.

Philosophy behind the Astronautics Division was derived in the plant's mission (AWM) May 20, 1957, p. 121 and was carried out by astronautics engineer firm of Perini & Associates, McNeil Construction Co. had given contract for contract cost of which approximately \$30 million and funds were supplied by Comsat. URM has approximately another \$10 million in funding and some test facilities.

Center Commanded

Principal speaker at the dedication ceremonies was Dr. Hugh L. Dryden, Director of National Aeronautics and Space Administration, who commended Comsat for its work in various areas as well as its efforts including investment of its own funds to create projects such as MX-754.

Dryden emphasized that with space will now coming to the fore, and with the magnitude and complexity of such jobs required, a national space program will have to be financed which will have fullest support of the Amer-

ican people, government administration and Congress.

In its role as a research agency, NASA currently has a large proportion of its facilities and personnel working on space flight problems. Dr. Dryden said.

While much basic research and development can be accomplished in agencies such as NASA, Dr. Dryden said he believed it will be the job of industry to design and construct the space vehicles themselves for such applications such as in lunar descent, non-reusable space programs.

Dr. Dryden added that while the new National Aeronautics Space Agency, which is to be built around NASA, could undoubtedly eventually meet the talent and build the facilities to do it, the work involved under its title, the man and financial effort required would be out of line. Instead he said he feels that NASA was effectively in contact with existing organizations which have trained scientific teams and facilities, to accomplish the required work.

New types of engines are needed. Dr. Dryden said for space flight and new sources must be developed for a broad power during flight. Although design and development of new large thrust chambers on the order of a million pounds of thrust is being initiated

now, it is not necessary that the U. S. wait until these programs are available to develop. Construction of today's three chambers with several hundreds of thousands of pounds of thrust each can be accomplished either first to get the large amounts of power required for space work, initially, the speaker contended.

Research Effort

Space programs proposed for NASA are three-fold, according to Dr. Dryden, starting with adequate research effort on problems of space technology, development and use of commercial vehicles capable of meeting the demand for traffic data gathering apparatus, and the development and useful use of man-carrying vehicles in the exploration of the solar system.

From space stations, more data through the reception center area and through a sample of the engineering building, a part of the production building.

High bay sections of the research testing facility, where much test activity is accomplished was kept closed for several months.

Also noted were the research and development engineering laboratories, plus such other facilities as the gamma hall which is capable of reproducing

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Inquiries are welcomed on any phase of the solid-propellant field—from preliminary design to quantity production. Armstrong, Inc., McAllen, Texas.





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100G accelerations and in only with other environmental conditions. Astronautics 10 building complex is located on 257 acres on Kirtan Mesa, near Montgomery Field, 18 mi. north east of San Diego. There are today some data 1,224,600 sq. ft. which factors accounting for 579,000, cap. across laboratories, 297,600, engineering and administration buildings 117,700 each, plus other structures. Plant has more than 55,000 sq. ft. of windows.

Employment at Astronautics will be increased from present 5,200 to about 9,500 by year end. Of the Astronautics personnel a large percentage are off site, that is away from other the main San Diego plant, the Astronautics plant itself at the San Diego area.

J. R. Dwyer, recently elected a vice president of General Division of General Dynamics is manager of Astronautics Division.

Space Man Evaluation Begun in Mountains

San Antonio—A symposium group from the Air Force School of Aerospace Medicine is being and working at high altitudes in the Rocky Mountains, collecting data which will help select the first man to go into space.

Living at the 11,000-ft level on Mt. Evans in Colorado, the group will climb to 14,200 ft to set up a mobile laboratory and persons chamber. In a 45-day program the USAF scientists and technicians will perform such physical contacts, such as running and climbing, and record these physical reactions to such extreme at high altitude.

Data from the mountain expedition will be added to information collected during three months of physical contacts testing and living here at the School of Aerospace Medicine. After they return to the school, members of the group will go through tests in the space cabin simulator.

Cabin tests will be used in determining the age, physical condition and personality of the type of man best suited to travel in space.

Mountain trip has several goals. The researchers gathered will set objectives in the discussion on the best type of man to send into space. While gathering the data the group will also try to find ways to increase time of consciousness after loss of oxygen at extreme altitudes. Members of the group also are preparing themselves physically and mentally for later tests here in the space cabin simulator.

The group is headed by Dr. Benson Teller and Dr. Bruce A. Gross of the Department of Physiology and Biophysics, and it includes five selected technicians.

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Disassembled Matra Matador missile is transferred from transport vehicle to zero length launcher at Gerson base.



Black crane picks up Matador's empty wing (above). Below, missile crew installs wing on transport. Wingspan is 25.7 ft. Crew of six men can get Matador in operational readiness in a short time. Zero launcher can also be used to transport the missile.



An F-400 transport crew installs Matador into zero launcher which carries the warhead. All weather missile has 500 mi. range.

USAF Matador Team Trains in Germany

McDonnell Douglas has focused attention on the concentrated missile training program under way in West Germany where 761st Tactical Missile Wing is part of U. S. Air Force Europe's atomic striking force. Wing officers F-100 and F-105 jet aircraft to some 100 missions of TSM-61 Matra Matador guided missile. Actual firing is done periodically at Wharfedale 4200 Airbase, North Carolina. Wing has three groups based at Eilberg, Hahn and Bentzen, in western side of Rhine River. The groups will be equipped with Matra Matador missiles, using AIRAN guidance system, later this year. Current Matadors are fitted with Simulac guidance system which requires forward target data from aircraft. Officers said 761st TSMW is completely mobile and can operate from a prepared position within minutes. Matador has solid-mounted inertial body, which provides 10,000 ft. thrust for about two seconds. This accelerates the missile from 0 to 100 ft. in rocket-propellant burn-out. Member's 4200 Airbase (D) A-107 missile system continues inside in flight. Rocket body is designed to be composed of an end stage about 600,000 sq ft in front of launcher. Matador is 35 ft. long and has wingspan of 25.7 ft. Zero-launcher pad applies missile with electric power, cooling air and steering fuel. Launcher also directs missile into firing position, can be used to transport fully loaded Matador. Missile can reach altitude of 15,000 ft. at speeds up to 400 mph. Wingspan is 25.7 ft. TSMW is now staffed continuously and one week crew.



North American F-100 Super Sabre fighter jets carry Matador missile launch pad at West German site. Jet fighters and bombers are used to transport missile's light.



NORTHROP N-156F mock-up is shown with various components, such as tank open. Equipment is installed on lower deck for ease of maintenance. Wing-to-main fuselage would probably carry telescopic sensors or radar sensors. Note unusual antenna that resembles an old pilot on top of the vertical stabilizer.

NATO Studies Northrop N-156F Design

By Russell Howland

Los Angeles—That the highest possible fighter performance does not rule the high air defense force is the underling design philosophy of Northrop's N-156F. Made by U.S. defense industry designed for American, NATO and NATO air forces (AW April 21, p. 100), it is the basis of the "class" fighter concept now being seriously studied by some U.S. fighter nations.

Needless to say, in this world, long distance combat is the main concern of the airplane's two General Electric J65 or T400D-105 engines, fuel, speed, and low speed performance and lower costs. Normal growth of engine performance, with engines, is expected to put N-156F in the Mark 2 class. It will fly for the first time in July 1979. The former version 1-15 will fly in December 1978.

Engineers around which the airplane was designed have sometimes been reported to have, these low-weight rates of 1 and especially low specific fuel consumption. Because of the weight saving implicit in these figures and the operation of a growth factor of about 1.5 in fighters, Northrop is able to claim performance for a 12,000 lb gross weight air fighter which is inferior to only a few heavy fighters.

As shown and expected, as designed in 1960, projected with a measure of heavy, successful, today. Northrop focuses the N-156F fighter under heavy in foreign countries without subsidy, at least, industry funds in U.S.

Design Philosophy

Northrop philosophy of movement performance in fighters, not on this, is the key.

• **Fighter performance** has become a low, significant factor in the design plan, of combat tactics, not on force, or performance.

• **As performance** is pushed up near the limits of the state-of-the-art, cost figures are lower than performance figures.

• **Fighter force** is a nation can support in combat or in practice, is limited by its capital resources and skilled personnel supply.

Northrop engineers argue that if the best element of performance is in lowering low, important and more easily, then a more performance low is only one possibility. All fighters, however, which development, have an better spent on getting the total lifetime cost of the nation, rather than one time for the purchase of a large number of airplanes and support units.

Increasing range and accuracy of its in its missiles and better anti-air-

ing systems are making strength of weapons, more, important than ever, more fighter performance. Number of fighters which can actually be put in the air, or ground, increasing, and is contained in total airplane cost, rate of the nation's logistic requirements to logistic capacity, availability, and the production of total force which can be put in the air at a given time and degree of vulnerability, as the ground to create action. Vulnerability between weapons is an especially important factor, because of its effect upon mission rate.

Operating Costs

Operating and maintenance costs are 60% to 80% of total cost over the five-year operating lifetime of the airplane, and are closely related to logistic requirements, availability and vulnerability. Complex, delicate, vulnerable, present weapons performance, fighters are, available, and difficult to service. This leads to reliability and durability, more, more hours of skilled maintenance, lower, improved, checkout and repair, equipment and large stock of spare parts. Thus, along with better fuel requirements, more logistic capacity and reduced the number of airplanes which can be supported in mission.

Maximum performance fighter is a, improved of strategic mobility and with

- **Dependence** on heavy logistic support which has it to the end of all well defined, with, extended supply lines.
- **Need** for heavy, costly ground support equipment and raw maintenance skills which give the fighter to well equipped and staffed permanent base.
- **Need** for long mission times in the vicinity of low speed, low altitude, performance which limits the number of acceptable into far base.

Northrop studied the consequences of Mutual Defense Assistance Program countries in light of these strategic requirements and concluded that there was a need for aircraft quite different from those being designed for USAF for several years. Allied air forces could not be equipped except by giving them second-hand USAF aircraft and writing off the cost as mutual assistance grants. The concerns of Europe and Asia were unable to finance or build airplanes of equal merit and it would have been politically and economically difficult for U.S. to offer them brand new, first-hand USAF airplanes. A secondary aspect of the giving of new airplanes was partial endorsement of USAF out of mutual assistance money which helped finance new equipment for U.S.

Northrop felt that these factors have dictated the mechanism of the new airplane, arrangement in recent years.

- **Growing strength** of NATO and NATO countries, making more of them to provide at least a large part of the cost needed to purchase aircraft designed to their own special requirements.
- **Being out of U.S. resources** makes it less, less, ability to July and its allies.
- **Increasing demand** of U.S. more more performance, mostly for heavy



LECTION and placed for N-156F was two-stage propulsion—takeoff and takeoff to provide acceleration to get pilot into vertical climb at high speed.



TAIL CONE injection for engine maintenance is demonstrated on N-156F mock-up. Tail cone is attached at six points. Engines are supported on rails at top of fuselage. Northrop designed only for high speed, making it possible to remove engines without having to use high speed test over rails.



DUMMY in position for engine maintenance is demonstrated on N-156F mock-up. Tail cone is attached at six points. Engines are supported on rails at top of fuselage. Northrop designed only for high speed, making it possible to remove engines without having to use high speed test over rails.

light support long ranges and highly skilled well equipped maintenance teams is getting behind the capabilities of modern nations.

So advanced is the technology needed to operate and support modern performance aircraft that a few nations have been obliged to turn down the offer of Coburn since fighters because of inability to keep them in the air. The Dutch air force reported that its conversion from Republic F-84G to F-105 caused a 25% increase in dollar manpower requirement because of the more advanced technology in the latter version. This step up to Coburn series aircraft is a long one technologically.

From Allied countries (and even with the possible exception of Germany) that will not be able to sustain a high ranking effort of the Belgians. Air Staff told Northrop "If we are forced to accept some simplified equipment we will not have a high a degree of combat readiness. We can accept three or four of the U.S. to help to meet our NATO commitment with some equipment. Because of the higher wages paid and other cost factors, this would be far more expensive than offering an aircraft we need and can support."

Published estimates indicate NATO air forces alone will need over 4000

fighters of all categories by 1968. With the N-155F. Northrop would absorb all initial design and strike fighter sales, gross—obviously with the intent of capturing the largest part of this market by offering an all purpose fighter. Tactical flexibility, advanced all-weather, approach would appeal to use from, maneuverable to obtain a wide variety of special purpose airplanes in tactical combat to cover all possible contingencies.

In trying to sell the N-155F to air forces are facing Northrop has faced three obstacles:

- Emotional resistance to the idea of having airplanes which cannot fly as high and as fast as first line USAF and Russian fighters. Decline in combat potential the equipment of these forces in terms of national pride and high performance figures which are more important to the, by public than subtle tactical and strategic advantages.

- Allied air forces are unconvinced by having airplanes still in development because of their past reliance on second-line USAF equipment.
- European manufacturers are selling strike fighters to the same market as the active political support of their governments. French and German governments, particularly, have been trying to build interdependence. Germany is once again along the French with the military alliance.

- Confusion of N-155F concept because with that of NATO strike fighters is detrimental to sales prospects of both. Strike fighter is designed strictly for the support of ground forces. N-155F superfluous if not to somewhat more expensive. Speed and altitude limitations are designed into the strike fighters in contrast but this will not be known as from Army support troops or from missions. Ground attack capability of N-155F is designed primarily to be used against enemy air bases and mobile launching sites.

Development Program

Many of Northrop's sales push has been addressed to the U.S. government. Congressional officials feel that a development program in offering out a low, effective cost airplane and financed out of national interests, money would result in a support system that could be manufactured easily because and powerful without U.S. funds. Allied governments. Military attachés of Allied air forces would be interested in their special strategic requirements and cost of U.S. financing and would be required. Endorsement by USAF would sustain advance program argument based on N-155F matches to match speed and altitude of contemporary aircraft performance superior.

Development and transition costs.



Allison Develops Army Turboprop Engine

Turboprop version of new 250 hp engine being developed for U.S. Army by Allison Division of General Motors Corp. will weigh 185 lb. and will be 39 in. long. 340-horsepower model is expected by Sep. 19. In Britain, Army Division of Development and the Western Military Area, Division of Research. Turboprop engine will be used in observation and order aircraft (AW) Job 71, 330. A turboprop version 15 in. long and weighing 90 lb. will be used in Army helicopters. Both versions will be manufactured by Allison.

would be maintained in close relation ship of N-155F to N-155. Northrop is looking for 50% of the parts in the two airplanes will be interchangeable. All of the engine in which there is very little difference between the two. The fact that this will be not going along the same learning curve is considered major cost and time saving factor by Northrop. T-15 is available and will be the first. Over 100 engines have been specified on the wind tunnel program which is now over 70% completed. Program involves 7,400 lb. of thrust test. N-155F will meet over 1,500 lb. thrust in the learning curve.

Northrop has investigated five different test methods for N-155F and has none as less suited on turbine, simple and the others highly sophisticated. No effort will be made to firm up on one as the other being points but evidence was which is their ability to maintain complex standards. Also studies separate rating, desire that some countries are not capable to receive the most advanced versions.

A fighter designed for service with out one lot all of the NATO and NATO countries and cope with a wide variety of speed requirements. In Japan, political considerations favor the use of a two-engine fighter such as the N-155F, public has become very sensitive to human values. A single fighter cannot be the result of a single engine up an individual and gas, explosives, a fuel pump and engine right temporal performance demands. Nor Northrop still hopes to sell N-155F in

Japan despite extensive agreement under which the Japanese would buy and build German F-104. Relations and activity follow by two-engine design are less falling points.

German Market

Northrop officials think it likely that Germany will buy N-155F and as a result the Lockheed F-104 plan in which the East G-91 strike fighter which is already ordered. They consider Germany to be one of the few Allied countries with the economic strength and technology necessary to quickly incorporate performance fighter like F-104 and also able to afford the speed-up in the strike fighter concept.

They believe Germany's strategic and political considerations cannot be plain in the N-155F as the air defense structure. Number of reasons which can be stretched to accommodate more than performance fighter is limited by cost. Yet German government has right of command down. This action German air force would be compelled to buy land on the side's needs, regard of how high to provide a big, many of them. From existing aircraft bases would still be relatively small units which to be maintained. Northrop believes N-155F operating from small advanced fields could take some of the heat of the big bases in offering a comparatively land-to-land defense.

The Air Force and NATO are working along the later phases of World War II when USAF and NATO could destroy German bases almost at will. Left

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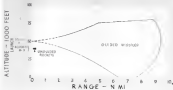
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LETHAL ZONES IN ELEVATION



DIFFERENCE between kill rates of graded and ungraded treatment demonstrated greater freedom of selection at fence point by NISG equipped with graded circles.

saife squanders and whole support was rotated continuously among a large number of small temporary bases called 'Eunates,' some of which were located on straight segments of the Autobahn system. The Luftwaffe continued to put up a desperate resistance long after it should have been routed because the Allied reconnaissance discovered German stores at an Eunat, a town

could seldom be organized before the fighters' world went on to another. Whenever the fighter syndicates went they were preceded by night-driving, anti-social acts and numerous, chaotic collisions.

Northrop proposes the F-16s be used in N-170 squadrons. Its value could be augmented by use of extra length launch booster and ground support equipment of Marine Meteor surface-to-surface; much could be converted to this purpose.

Combat Mission

N 1181 is introduced for its top speed as well as its air-to-air armament and low 748 km combat radius. Most efficient way to eliminate enemy air and missile power is to attack it on the ground as depicted in figure 4. Support: Ability to hit targets on the ground enables N 1181 to provide close support of ground troops but speed range rate of climb, cruise ceiling and special fire control equipment needed for air intercept remains unclear if a more expensive air plane than the true cruise fighter.

Countdown Lighter dropped under the philosophy of the N 146F is still much less expensive and much more easily maintained in combat than one designed for the very ultimate speed and altitude. Aggers stresses it is impossible. Nothing studies indicate that the last 5% increase in performance, growth for 50% of development cost, and is usually obtained by increasing production costs, operations and maintenance costs, strategic mobility, logistic requirements, and equipping availability rates.

At the beginning of the N1751 project it was apparent that the new design would be competing against Mach 2 aircraft, not Northrop's close

The Effect of Nickel in Alloy Steels

Each element in an alloy steel has its own particular job to do, and each is included with a special purpose in mind. What are some of the reasons, say, for using nickel, chromium, molybdenum, vanadium, and other components that appear in the various analyses? The elements in any alloy steel work both individually and as a team. What does each one do? In this and subsequent discussions we shall try to answer these questions, beginning with nickel, one of the fundamental alloying elements.

Nickel increases toughness and resistance to impact, particularly at low temperatures; lessens distortion in quenching; improves corrosion-resistance. It lowers the critical temperatures of steel and widens the temperature range for successful heat-treatment.

Nickel steels are particularly suitable for case-hardened parts, such as aircraft-engine gears and roller bearings. Such steels provide strong, tough, wear-resistant cases and also ductile core properties.

Advantages imparted by nickel are not restricted to quenched-and-tempered steels. Nickel often permits given strength levels to be obtained at considerably lower carbon contents, thereby markedly in-

B

This is the work of a career of achievement dealing with human facts about policy itself. Though much of the information is elementary, we believe it will be of interest to many in this field, including more of broad experience, the way God did it won't be missed. Simultaneously from time to time

creasing toughness, plasticity, and fatigue-resistance. Nickel steels are therefore highly suitable for applications where liquid quenching is not employed, such as high-strength structural steels used in the as-rolled condition or heavy forgings not adapted to quenching. Products of this nature must develop superior properties after nothing more severe than air-quenching treatments.

If you would like to know more about nickel steels, or need information about other types of alloy steels, please feel free to consult with Bethlehem's metallurgists. These technicians will gladly advise you regarding analysis, heat-treating, machinability, etc. You are invited to make use of their services whenever you need assistance.

And may we remind you, too, that Bethlehem makes all AISI standard alloy steels, as well as special-analysis steels and the full range of carbon grades. We are always in a position to meet your needs promptly and fully.

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rough a Mach 1.5 speed burst and less most of its development effort to the problem of measuring the number of cycles which could be brought into play. I agree, the shock could be right as defense. A fast response can detect a major shock that a slow rate but it could be more than twice as fast to cover the same sector in less shock response.

Custom of designing fighters to out perform bombers got out of the present case and led close tactics needed to out maneuver, speed and improve hit probability of gas and improved rocket response.

Obsolete Tactics

Most fighter tactics as conceived that aggressive bombers and guided air-to-air missiles have made these tactics obsolete. Longer range and self contained guidance of weapons as to its targets has made it almost impossible for probability of success to be high. A superior fighter could not do the job because of a superior bomber was not close to within short range before the launch where loss is nearly assured.

- Flight time to the strike line is a factor in the high speed of the bomber and the use of no ground targets.
- Lighter and closer to the target in a fast chase approach because speed of attack relative to its target is less on an attacking bomber than it is on a chasing or leading bomber.

• Visual time distance is lost to moving into the bomber's leading to lose the speed vector of the two airplanes and similar as quickly as possible, but as well as that in rapidly converted during this period.

- Wide turning radius of high speed fighters were present most long as ground was the threat with the target beyond the range of air-to-air missiles. This would call for an excellent Ground Control Intercept (GCI) system which might not be available after the first day of attack is completed.

Upgraded aircraft might be built within some envelopes of range and other characteristics. Rapid change makes fighter is difficult to place within these envelopes and is there for such a hard point that the human pilot is incapable of maneuvering and moving in the direction available to him. During the long era he must be removed from control of the weapon and replaced by some machine for control. Only way out. Control is no longer needed, allow the firing point to be programmed much more simply in time and space. Pilot can be put back in the cockpit with a "top" weight using in the control system and an improvement in it is better and cost.

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last 100 years, different agricultural practices in rapid, dramatic reduction and evaluation of military and commercial value. Currently, hunting is discouraged for some animal's species of

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PROLAPSE OF THE LENS

The steps by which man approaches the Space Age consist, in major part, of advances in control technology.

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position reduces the significance of fighter performance in the final run. Forward hemisphere attack actually makes good a disadvantage since it increases closure rate and reduces the time available. Advancing traditionally endowed by altitude may also be disappearing with advent of guided missiles. Better reduced and solar returns can be had in attacks from below, escape may be easier and the tail saved by not climbing to a higher altitude offers more combat value.

The N-156F is designed around these characteristics of guided missile armament. The missile is intended for use by the fighter's basic role: to top of their early warning radar line and with GCI systems ranging from good to non-existent. Moreover, the missile's penetration and maximum GCI dictate use of increased homoplane attack. Therefore, all the performance needed to get enough speed and rate of climb to get the fighter between the bomber and its target in the time allowed by existing early warning systems and high enough speed and climb to get away from the bomber's radar. The bomber's operational ceiling. Nevertheless, the N-156F offers that for all its potential.

Scudlings tried out its concept in a series of telephoto exercises on paper in which a maximum performer, Mech 2 fighter and N1541¹ were pitted against identical Mech 1.5 and Mech 9 bomber raids into West Germany. Each fighter force was processed, trained, operated and supported for the same measure of money and within the same logistic constraints. Each took as much advantage of West German strike opportunities as possible given the varying characteristics of their respective missions.

Agreement used fire control systems were identical.

Successful Intercepts

The N156F laser made 1.7 times as many successful intercepts of Mach 1.5 targets as the minimum performance level of 1.0, and 1.75 times as many intercepts of high velocity (Mach 2.0) targets. The highest number of intercepts ranging from 30,000 ft to 60,000 ft and N156F shot from altitudes between 45,000 ft and 55,000 ft. Best range of N156F was only about 20 ft below that of the minimum performance fighter at altitudes above 75,000 ft, though top speed was more than 50% below. Fuel consumption per shot was one-half that of the minimum performance aircraft.

Purchase price of N-156F was a lot less than that of its competitor and maintenance man-hours per flight were also approximately half as many. These facts gave N-156F an edge despite its

back in school and athletic possibility.

According to Northing calculations BLISSE should have these advantages:

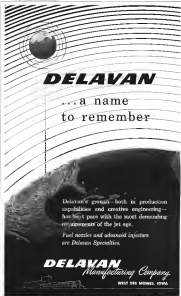
• **Strategic mobility.** The N-156F's income can be dispensed in more than 1,000 ft. runways and highway segments not usable by other fighters and mobile support units are more difficult targets than highly developed bases. Mobile N-156F support is made possible by simple modular systems and on rail fuel rockets, among. Not subject to freedom from easily interrupted supply network and fixed bases.

- **High availability.** Twin-engine design enables N-1GF to return after an *in-flight* failure of an engine. It also enables

possible duplication of hydraulic pumps and electrical actuators and eliminate the necessity of dead-weight backstop systems to guarantee action of the air alone after failure of a primary system.

• **Combat modes.** Northrop says 730 is a combat version of NIDSF suitable to protect a wider area and gives it a greater potential for offensive penetration against enemy missile pods, airfields and supply lines than most modern fighters. This is a necessity for some of Northrop's possible buyers like Turkey, which faces Russia across the Black Sea and must cross water to find targets.

The N-450P and its entry drive the



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T 13, infrared preliminary design near the end of 1955 when Northrop had secured the lightweight low speed/high fuel consumption turbojet engine being developed by General Electric and Fairchild Engines and Aircraft Corp. for missile applications. Fairchild Bell Co. and McDonnell Douglas' Quad counter-rotor engines were intended to serve the J61 and J65. Northrop engineers urged the development of the small, lightweight engines as an alternate back-up. No one, principle is involved but engines are more thoroughly engineered from the standpoint of weight, reliability and cost. General Electric 199 was first engine to bring weight considerations in at the preliminary design stage. It is now being advanced a three-stage ratio of 2:1. That weight ratio of 3:1 is claimed for J61 and J65.

Weight of two engines in N-158 is about 516 lb or about 27% as heavy as single engines used in many current high performance fighters. The two J61 or J65 installation provides about 50% in much thrust as the heavy single engine. Much of the advantage of the small engine installation is derived from the operation of the so-called Super-Cycle or 1-2 Power Law which states that the thrust of a turbojet varies approximately with the square of the characteristic base engine diameter while its weight varies with the cube of the diameter. Cost of the two small engines is substantially less than that of a single large engine. Airframe cost of N-158 is about half that of a current Mach 2 fighter, so far, cost amount to about 60%. Maintenance, fuel, personnel, training, attrition replacement, refurbishment and fixed costs rise to approximately 65% of those costs for a minimum performance type. The total early cost of procurement and operation with procurement assumed over a four-year period is between 60% and 65%.

The N-158 will take off and land at a 5,000 ft sea level airport over a 18 ft obstacle. It touches down at less than 120 in Northrop engineers say they could have entered 1 Mach number higher maximum speed for the take-off run for the low but only in landing field length is 3,000 ft. Normal engine performance growth is expected to push maximum Mach number up around 2 without any further on the low end of the speed scale. The growth will come just at the beginning of their growth curve. Normal growth of thrust in the competitive class of an engine design is about 40%.

The airframe is now ruled and has a very extreme wing-moment in the forebody with the wing root. Area rule design point at Mach 1.5. Drag rise at Mach 1 is 30% of the total.

Quarter-chord line of the wing is

except back 25 deg. Leading edge is swept forward 30 deg. Leading edge extension at wing root has 60 deg sweep. The wing has no dihedral and aspect ratio of 1.75 and a thickness ratio of 1.5% with maximum thickness occurring at about 47% M.A.C. A small number of control surfaces is used on the leading edges which is equivalent to about a three degree leading edge droop. If it were not overhead, such leading edge would cause stall to occur at an angle of attack of about 10 to 15 degrees. Control surfaces still in an angle of attack of 10 deg N-158 will have leading edge thin which extend at eight degrees presenting angle of attack to be increased even higher before separation occurs.

Access and flaps are both 30% M.A.C. deep. Flaps extend from base line 11% sweep to 90% sweep. Access extend from base line 75% sweep. Boundary layer control flaps are being investigated but there are no firm plans to install them. Stability of the N-158 has been simulated on the variable stability P-50F at NACA's Ames Research Laboratory. It is intended to have good lateral stability through the stall. Pitch and roll stability augmentation based on rate gyro will be installed to damp high natural frequencies at supersonic speeds. Loss of the augmentation would not be considered especially dangerous at an integrated speed, Northrop engineers say, but control would be hard work for the pilot.

Lots of stall reduction has a three degree negative dihedral. The large late is at 30% exposed M.A.C. All tail surfaces have some leading edge sweep at wing and 45% thickness ratio. Rudder is 30% M.A.C. deep and 50% sweep back.

Subsonic wind tunnel testing was done at Northrop's own facility. Transonic testing was done at Cornell Aeronautical Laboratory and supersonic run was made at Ames military tunnel. Northrop also expects to use the nation wind tunnel at USN's Arnold Engineering Development Center.

Package is constructed of steel fusion and T-71 titanium. Some sections are in steel 7051 but some supersonic is steel clad, notably in the engine air inlet lips and about 40 in. aft. Titanium shrouds are used in the engine area. Two extruded and free stepped extruded longmen provide a strong base point attachment between the wing and center fuselage sections.

Wing Structure

The wing has a wing-root pattern structure with six main members on its structure. Main transverse cross ribs, drag leading and side-dip loads. Forward spar is at 15% M.A.C. All other transverse spar is at 40% M.A.C. Trans



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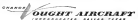
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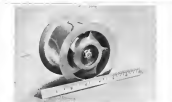
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is a discontinuous span at 66% mac which serves only vertical loads and has a fore and aft slip joint at the root to allow fuselage loading. There is a single tapered skin on the upper wing surface and another on the lower surface comprising a single, complete structural box. Wing skins extend all the way to the tips.

Stabilizer is a honeycomb structure in cross-section of a single structural box with one spar at the center, to which the rudder torque tube is attached, and two side spars, one forward and one aft. Stabilizer torque tube is continuous through the fuselage with an assembly joint in the middle. Removable tail cone has no structural joints. All internally stressed fuel is kept in fuselage bladder cells. About 90% of the fuselage is in the fuselage center section as blind bolts. Fuel ductwork is a double feed in the nose tanks connected leading lines.

A hydraulic pump and an electrical system alternator are driven by each engine drive in summary path through an extension, drive and a booster, pressure mounted gas loss automatic governors controlling the gas loss speed selection across the range of frequencies to the alternator while making the weight, torque and unavailability of constant speed drives and provide high

volume flow in the hydraulic system at turbine pumps without causing excessively high flow rates at maximum power settings.

About 95% of all electrical equipment has been chosen because it is inherently resistant to fungus and salt. Two-speed drive allows frequency to range from 120 cps. to 480 cps. The remaining 5% of the a.c. loads have an additional upsurge to hold frequency within higher band. There are two separate a.c. load buses which operate unparallelled unless one system fails in which case, the other takes over the entire load. All essential loads are an integral part of one automatic set including the things which are electrically driven. Batteries provide the small amount of d.c. needed for such things as instruments. Battery is used chiefly for preflight checkout.

All controls are hydraulic powered and without manual backup systems. Each control surface has dual actuators. One set is driven by right engine and the other set by the left engine. Each set has one engine or one system allows full control deflection, but reduces hinge moment capacity by half. Both hydraulic systems operate at 3000 psi. Landing gears are retracted and extended by the left hand system. Gyro and accelerometer drag upon the forward retracting mechanism provide the power for emergency extension. Multiple disk wheel brakes are operated by a separate open center system powered only by the right leg drive. This is considered safe quite because of the light weight of the airplane. A engine cut will be as critical in a pressure packed, incompressible medium and will be instantly released. Arresters will be used in a center because of the wide variety of possible arrangements to be used for the many potential customers. Electronic crew intercoms would be added.

ARDC Encourages Materials Research

Dallas-based materials are the common denominator in the effort to reduce weight and improve efficiency, reliability and life expectancy of new weapons, Maj. Gen. Marvin C. Decker told a symposium on materials sponsored by Air Research and Development Command.

Development of new and better improved materials will lead to subsequent improvements in the performance of aircraft and subsonic weapons, according to Gen. Decker, ARDC's deputy commander for R&D. Calling for the resolution of the civilian scientist and industry community, Decker said the scope of the materials problem has become as broad and

complex that only by a combined effort of military and civilian scientists and development groups can the U. S. meet its national defense goals.

Space flight has complicated aerodynamic research and development problems, since the first ARDC materials symposium was held in 1955, Gen. Decker said. Regardless of the medium in which the Air Force must operate, an aircraft contains elements to provide superior information to ARDC. ARDC's response was held to provide an exchange of information among military and civilian specialists in the field. ARDC discussed its future objectives and the materials difficulties that stand in the way. This was an effort to perform scientific groups in industry and the universities of ARDC needs so they can use toward specific goals.

Sikorsky Predicts Helicopter Load Gain

Boston—Within the next 10 years, type Sikorsky predicts helicopters will be capable of handling up to at least 100 tons in weight. Within five years, he feels, more than 50 tons could be being hoisted from 30 to 25 tons.

Speaking at a General Helicopter Society, meeting attended by top ranking Army officials, engineers, scientists and industrialists, Sikorsky said that the main thing would be to modify or dispose with the conventional heavy rotor and provide a lightweight rig allowing the load to be hung under the helicopter bells at the base of the rotor system. One of the two pilot seats would have to be dropped to form through 100 deg. and controls provided so that the machine could be flown backward with ease. Larger machines would also have a third seat to look after and operate the lifting gear.

In the future, Sikorsky said, the function helicopter being used to tow ships or vehicles and to load heavy objects, helicopter companies would be carrying "load-in-line" services over distances fixed to carry passengers. Although he forecast no technical obstacles to building 300 passenger helicopters, Sikorsky thought the idea would not catch on because the effective range of the machine would be limited to about 175 mi. nonstop. He said five 60 ton helicopters would probably pay off better than a single 300 passenger machine, but even under the most favorable circumstances it would be next to impossible commercially to fill all the seats of a plane loaded each day.

Future long-range helicopters will probably be amphibious, concluded Sikorsky, so they can be refueled from tankers at sea.

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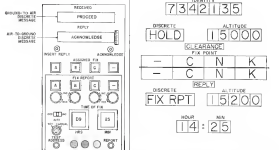
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AVIONICS



COCKPIT controller display will display AGACS messages received from the ground, also will be used to input data to reports and various messages. Lowest three rows are for experimental evaluation tests. At right, ground controller's display shows display data to report and message that controller wishes to transmit to airplane. Controller checks message data before sending it

AGACS Data Link Eases Pilot Chores

By Philip J. Klein

Washington—Work has begun on a system that is expected to provide the most significant improvement in air-ground communications since the introduction of two-way radio-aided descent gear.

The development began the worldwide series of Automatic Ground-to-Aircraft Communications Systems, abbreviated AGACS with use of the acronym "G" meaning as it can be pronounced "Gee." When the concept has been prepared more than a decade ago, it was called Air Traffic Control Signaling System (ATC2S) and remains identical in concept to that data link.

AGACS is being developed by Kollsman Corp. of America's Defense Electronics Products Division under Aeronautics

Research Board sponsorship (AWR June 50 p. 38). Studies will use many of the techniques developed by RCA for the new data link system it is developing for Air Force and Navy. Its potential value is held to be in reduction of human error which has caused 100 deaths in August 1958.

Highlight Features

- **AGACS will track** three types of aircraft without requiring use of any additional voice data.
- **Automatic altitude reporting.** In an airplane, will automatically report its barometric altitude at frequent intervals to ground traffic control centers with no requiring any action by pilots or controllers. Altitude reports will be made at least once in two minutes, more frequently if traffic is tight.
- **Sometimes will be reporting.** Once the pilot has positive identification of the aircraft, he will push a single button at airplane controls at fix to transmit position identification. In some instances, he will transmit altitude to ground traffic controller and traffic controller (computer). Eventually when it has, automatic reports come into position reporting could be continuous and automatic.
- **Random message exchange.** Pilot and/or controller can transmit choice of 12 different message messages to the other. Typical controller-to-pilot messages include: "Descent to 7,000 ft," "Hold at Fix XYZ," "Representative pilot-to-controller messages might be: "Request higher altitude." Selection of the most frequently used and common messages is made by AMB study. Initial selection can be easily changed if operating conditions require it.

AGACS is intended to relieve present voice communications, as appears at Vint. It will be used for noncritical and emergency messages.

AGACS is a digital communication system whose messages consist of short bursts of pulses exchanged between air-

plane and ground. At least one, every two minutes, most often if traffic is not heavy, the ground transmitters will automatically send AGACS equipped air plane in the area. Ground messages down into the airplane's barometric altitude and new altitude via one of 12 voice messages that traffic controller sends to him.

Such messages normally are addressed by, and received by, only a single airplane. However, messages can be sent simultaneously to all aircraft by means of a "broadcast" address. If desired, flashing light or constant display which pilot to new message and he sent subsequently push a button to acknowledge receipt so controller knows the message has been read.

Automatic Reply

When the airplane is interrogated, it automatically begins by giving its identification, barometric altitude, plus any altitude message or fix report that pilot has set into cockpit controller once last interrogation.

The reply now also includes report-back of ground message for double checking purposes.

Total time required to send ground-to-air message and receive and to transmit airplane's reply is 0.24 seconds. Thus 240 aircraft can be serviced per minute on a single frequency. Aircraft are interrogated in a well set sequence except when the ground controller wants to send a message which goes out on a priority basis in next 0.24 sec. and interval.

AMB flight tests will determine what AGACS service at intervals of up to one minute two minutes for heavy traffic conditions) is adequate for on-voice situation. If so, a single frequency can serve 100 aircraft. A message frequency (frequency) will be used on terminal unit to provide more frequent service, perhaps once every 15-16 seconds.

Basic use of the AGACS rule as to how it will appear to both pilots and controllers.

- **Reduced cockpit chores.** Automatic reporting of airplane altitude, position, pilot action, and push-button 12



GROUND controller will compose AGACS message using one keyboard in which he communicates with traffic computer being developed by General Precision Laboratory.

porting of airplane position for data should actually decrease flight crew's chores.

- **Reduced frequency changing.** Unlike present voice communications, when pilot must frequently change frequencies along the route, it now appears that a single AGACS frequency will handle entire Air Route Traffic Control Center area, and another frequency will suffice for all terminal area functions.
- **Less confusion.** Transmission of one fix divide by report information and receipt into AGACS is reported by ground-to-airplane communication in a single voice communication, eliminating delay in radio contacts between pilot and controller.
- **Better intelligibility.** Visual display of status messages on AGACS in both cockpit and pilot control areas should cut intelligibility problems which now result from cockpit noise, poor microphone, technique and/or foreign language difficulties. This has been pointed out to airport remains designed as cockpit indicator until updated by new message. Ground controller, upon receipt of new AGACS message from aircraft, can call out its pre-set message from storage to inform his actions.
- **Direct computer communications.** AGACS "language" is directly compatible with language of traffic control computers which General Precision Laboratory is developing for AMB. This means that automatic altitude and fix reports can go directly into computer without human intervention and the resultant risk of error. The computer will transmit altitude reports, report computed with last previous report, and estimated time of arrival at next fix. If there is no serious discrepancy, the computer will just out the fix arrival information on controller's flight display strip. If there is a significant deviation, computer will flash warning light on controller's console alongside flight strip of appropriate action. Controller can then push button to display latest aircraft report and decide what action should be taken.

The AMB/ACA system is designed to work with existing airborne VHF communications receivers and transmitters built to Air Force and Navy standard military standards (VHF equipment AMB also wants to analyze feasibility of using AGACS for long-distance operations and has asked RCA to design experimental system to permit operation at lower data rate.

One of two communication equipment carried by an aircraft would normally be assigned for AGACS use, the other for voice. However, one operating with AGACS is entirely available for voice use if needed.

To begin an airplane for AGACS will involve addition of a data processing



COCKPIT instrument display assigned altitude transmitted to AGACS and, second, series altitude. Needle indicates that the airplane should climb.

unit and cockpit display. Engineering needs which RCA is scheduled to discuss the flight tests in fall of 1959 are expected to weigh about 40-50 lb. It just experience is an extra, some use, night solutions should be possible in aircraft production equipment. Finally, lights, two supplementary AGACS units should also be possible for cockpit use.

Error Prevention

Many potential advantages of AGACS cannot be realized unless system can be made inherently reliable and accurate. This is more difficult for AGACS than for voice communications because of the considerable inherent redundancy that exists in human language.

An AGACS message consists of several groups of pulses. One group, for example, carries the identification (advice of the airplane to which message is directed). Another group of pulses in which one of the 12 numeric messages is being sent.

If one of the pulses in the address group should be "lost," because of a problem or other difficulties, it could change the address from the intended airplane 'A' to an address corresponding to airplane 'B.' If airplane 'B' also happens to be flying in the same area, the message intended for 'A' will be displayed in the cockpit of 'B.' If the loss of a pulse results in the group which carries the routine message, an incorrect message could be displayed.

Fortunately, many human errors would immediately be obvious to the pilot, traffic controller or traffic computer on the ground. For example, a pilot of a DC-3, cruising at 10,000 ft, would immediately suspect an AGACS message which instructed him to climb to 40,000 ft.

Similarly, the traffic computer on the ground would detect that something



AGACS message, including ground-to-air and air-to-ground, reports 240 aircraft

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and Scientists to work on*

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Lockheed Missile Systems Division, recently honored at the first National Missile Industry Conference as "the organization that contributed most in the past year to the development of the art of missiles and astronautics," holds such important, long-term projects as the Navy Polaris IRBM, Earth Satellite, Kingfisher (Q-5) target missile for the Army and the X-7 ramjet test vehicle for the Air Force.

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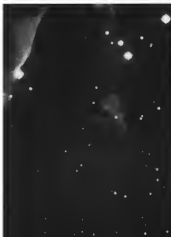
If you are experienced in physics; mathematics; chemistry or one of the engineering sciences, your inquiry is invited. Please write Research and Development Staff, Sunnyvale 2, California. (For the convenience of those living in the East and Midwest, offices are maintained at Suite 745, 405 Lexington Ave., New York 17, and at Suite 300, 840 N. Michigan Avenue, Chicago 11.)

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2. It will be radically smaller than currently developed land-based missiles, yet its payload will be as effective and its range the same as other IRBMs.
3. It will be the first operational outer space missile to employ solid fuel as a propellant.
4. It will travel through three mediums in a single flight—water, air and outer space.
5. Its launching base—a submarine—is not fixed but a mobile vehicle.

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Very little can be said about the Earth Satellite program at this time except that its success will approximate advancing the state of the art in all sciences.

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now wrong if it occurred an AGACGS outage from airplane known to be in flight from New York to Washington which reported the airplane over a few near Denver, or that the airplane had changed altitude from 10,000 ft to 25,000 ft in the two minutes elapsed since the last report. Such discrepancies will cause computer to indicate no light on controller's console, opposite appropriate flight progress strip.

Built-In Checks

In many instances loss of one or more poles in a message group will produce a flagged message that an error will be obvious. But RCA will employ other techniques to minimize possibility of error. For example, an on-air system is building one of six frequencies for reports to AGACGS, the aircraft reply will include in addition to its identification a report back on the last message and assigned altitude it received from the ground. This reply back is automatically checked by ground equipment against assigned message for correctness.

If report back is incorrect, AGACGS sends directly to aircraft a message asking message again, since some computers the airplane reply with the original. If two successive attempts fail to obtain correct report back, the system automatically flashes warning light on controller's console opposite appropriate flight progress strip.

Another technique that will be used is called "parity check," transfer to one computer in digital computers to prevent errors due to loss of parity in a group of message poles. In this system, known as odd-parity check, the total of poles in each group is made equal to an odd number, by adding an extra pole at transmission, before message is transmitted.

When a message is received at other terminal, the group of poles is examined automatically to determine if total is an odd number. If not, the message is reported as being in error. The odd-parity check operates similarly except that total number of poles is made equal to an even number and checked accordingly upon receipt. RCA's plan to use odd-parity check is actual of the message groups, even parity check for others.

Both airborne and ground-based position of AGACGS will have number of other built-in type features. For example, test signal transmitted every 30 seconds by ground transmitter enables it possible for pilot to check performance of his airborne unit. By depressing test button, cockpit indicator should display message, which alerts AGACGS station to check equipment in aircraft. If airborne unit is operating satisfactorily, each airplane normally should be come ground investigation at least

once every two minutes. The airborne unit will incorporate a timing mechanism which will flash warning light to the pilot to alert that the unit has received a group transmission for three minutes (or other interval established during initial flight evaluation).

A similar timing device will flash warning light if transmission is received from ground transmitter but not been received for a period of the minutes, in avoiding possible shadowing of ground equipment or other base failure.

If the ground station fails to receive an aircraft report from an AGACGS-equipped airplane on its radio, it does not run through an roll call before trying again. Attempt is made to intercept the same airplane 15 seconds later. If an reply is received, the ground station is made 17 seconds later. Failure to receive reply might be due to airplane being in a turn and its antenna being checked by position of unknown. If reception cannot be established, AGACGS automatically flashes warning light to the controller opposite appropriate flight strip. The controller can then use voice radio to try to establish contact. Ground-to-air message request for traffic controller using the same radio set equipped to enter data into General Purpose Laboratory computer, will be displayed to the controller before being transmitted to the aircraft. After check-up, the controller of the message, controller will push a button to transmit message in and time slot.

Technical Details

Here are some of the technical details on the AGACGS system which RCA will design.

- Type: Two-domain multiplex, capable of operation of single-channel or dual or double channel systems. Two-domain multiplex means that the messages to different aircraft are separated by a time interval in a self-sufficient sequence, rather than simultaneous transmission to several aircraft on different frequencies in an frequency-domain and time-division technique employed in existing Air Force data link.
- Data rate: 750 bits per second for VHF UHF operation. Data rate of 16 bits per second will be evaluated experimentally for HF operation.
- Message length: 80 bits for ground-air message, 60 bits for air-ground.
- Message mode: Two, required by transmission of ground message and air-ground reply will be approximately 0.24 seconds.
- Information rate: 750 per minute per channel.

In its proposal, RCA recommended use of frequency shift keying (FSK) in the test modulation technique for accurate reliable information from AGACGS operation. With FSK modulation, one frequency is shifted 12 Hz in one

direction to produce one of the two binary symbols ("00"-"1") that make up AGACGS digital code and shifted 15 Hz in opposite direction to produce the other. The UHF operation, FSK shift will be 70 Hz, unless UHF channel is selected to 40 Hz, in which case a 12 Hz shift would be used.

FSK modulation, theoretically, agrees the line to simultaneous transmission of both AGACGS and voice on a single frequency. However, some problems must be solved before this becomes an operating system.

After consulting with Air Transport and Aeronautical Radio Inc. engineers, AMR concluded that a FSK modulation system might require extensive modification of existing air-to-ground, ground-to-air, and receiver transmitters for AGACGS use. For this reason, AMR has asked RCA to study the problem and come up with an alternate modulation system which can be tried at a single FSK, in equal number of stations.

One possible alternative is the use of frequency modulation in which the carrier is modulated by one induction to transmit one binary number, modulated by a different tone to transmit the other. Another possibility is to use phase modulation in which phase of a 740 cycle tone is reversed. This modulation technique would permit use of coherent detection with a second signal-to-noise ratio.

There is considerable disagreement over the merits of different modulation techniques, according to William Reid, AGACGS project engineer at AMR. One of the objectives of AMR test system will be to evaluate the practical advantages and disadvantages of phaseFSK and the alternative modulation technique which RCA develops under actual operating conditions.

Representative equipment which RCA will deliver next autumn will that be tested to prove out fundamentals of the AGACGS system. Initially, equipment will be tested by General Purpose Laboratory's control computer and data processing equipment, until each system is designed.

Once this is accomplished, marriage of the two systems will be next major objective, because each team heavily against the other to achieve some of its potential benefits. For example, the digital data processing system will use waveform, which, in reports provided by AGACGS is updated its information on each airplane and to help decrease when airplane is deviating from assigned flight path or coming into conflict with another aircraft.

Similarly, AGACGS will depend upon GFT computer to verify validity of individual airplane report by comparing it with the previous report or computer predicted position of airplane.

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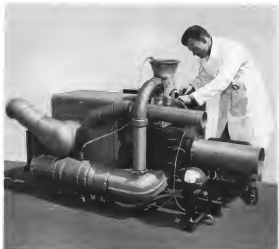
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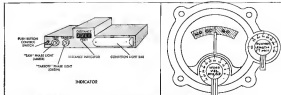
New Solar gas turbine auxiliary power units for KC-135 jet tanker

LATEST MILITARY AIRCRAFT to use Solar's lightweight airborne auxiliary power unit is the Air Force KC-135 jet tanker. Powered by bulky Pratt & Whitney gas turbines, the unit supplies auxiliary electrical power to operate necessary equipment when aircraft are on the ground. In addition, the latest Solar-built units are equipped with exhaust gas-to-air heat exchangers for cabin heating under severe temperature extremes.

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Two takeoff monitors designed to warn pilot of sub-normal acceleration. Arcon unit (left) displays distance traveled down runway, uses green as red light to show takeoff status. Deason unit (right) uses pointer to display status on continuous scale.

Takeoff Monitors Compete for Market

WASHINGTON—Two new takeoff monitors, designed to warn the pilot when his takeoff run is sub-normal in time for a safe abort, have been disclosed by Arcon, Inc., and Deason Helicopters, Inc.

Both monitors are airborne types, attached to cockpit instruments. They bring the total of such takeoff monitors known to be under development to five, including units by Kollsman Instrument, Minneapolis-Hennepin and Sperry Corporation described earlier (AVR June 13, p. 45). A ground-based takeoff monitor also has been proposed by Northrop Aircraft's Northrop Division.

Highlights of the two new entries, both carrying flight test phases, include:

- Arcon takeoff monitor continuously measures distance airplane has traveled

down the runway, determines airplane's ground speed. At a pre-selected distance, monitor temporarily slows ground speed with green light which craft should have achieved. If the airplane's speed is too low, the monitor automatically flashes a red light on cockpit indicator.

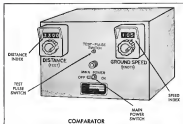
- Deason takeoff monitor senses airplane ground speed, compares its acceleration and compares this with "normal" value which airplane should achieve. Cockpit indicator gives the pilot's continuous indication of whether acceleration is above or below normal. Automatic alarm can be provided if desired.

Arcon's monitor, weighing about 5 lb., is essentially a modified version of the manual line-check procedure now used by military jet pilots. This is

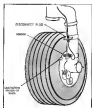
to compute what speed the airplane should reach at preselected points along runway, using charts which take account of such factors as weight, temperature, barometric pressure. During takeoff run, the pilot compares airport indicator reading with pre-computed value as his airplane passes check point marker along runway.

Arcon's monitor is based on using same charts and procedure, but the pilot sets required airport and check-point distance into the device before takeoff. He is offered of having to look for a check-point marker outside the cockpit, reading the airport indicator and making comparison with pre-computed speed required at that point.

To measure distance traveled down the runway, Arcon uses a small pulsed generator attached to track leading



COMPARATOR sets in pre-computed check point distance and speed in Arcon monitor.



Arcon measures airplane ground speed by means of a small motor on main gear which generates pulse each time metal hub on rim of tire rotates past sensor.

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gun and small device accurate as the car. Each section of the wheel provides electrical pulse to the pulse generator. The number of pulses from start of take off is proportional to distance covered. In process of differentiation with respect to time, the pulse count also provides speed proportional to airplane ground speed.

When the airplane reaches a preselected check point along course, the monitor compares airplane speed signal with voltage obtained from preset speed indicator. A flashing green light as each pit indicator shows that aircraft speed is substandard. During and light red lights (slow) is too low, cockpit indicator also displays distance traveled down the runway during take-off run, in terms of digital counts.

Avion system enables the pilot to check out certain portions of the avionics circuitry prior to takeoff by either of two means.

- Pushing "test" button prior to start or tracing course cockpit distance counter to advance in aircraft master rate position, checking operation of wheel pick off and certain other circuits.
- Pushing "test" button on controller produces signal equivalent to one rotation of main wheel. Pilot can push test button preselected number of times and check whether corresponding distance indication appears.

When the pilot is ready to begin actual take off roll, he pushes the "Take-off" button cockpit indicator. This operation could be designed automatically in being it is only release of button or advancing of throttle.

With present Avion design the pilot gets no advance indication of how accurate is accelerating until he reaches preselected check point. However, a common-sense system that the device has all the necessary input information to permit a continuous comparison of actual versus desired ground speed throughout the take-off run, if desired. Since additional computer would however, be involved. The action is completely instantaneous into three transmitters. Both 25 v.d.c. and 115 v.a.c. power are required.

Detrex Associates, Inc. (Lafayette, Calif.) "Detrex" is being developed by company a special device device. The device avoids the use of pre-computed charts in tabulating, but does require the pilot to set in runway length and wind velocity on the cockpit indicator.

Compensations for changes in barometric pressure is automatically introduced by means of an aneroid element included in the system which is connected to the engine's master air intake.

In simple construction, ground speed does not enter into master's computation. The system is calibrated to provide true mileage for maximum ac-

cure ground speed, according to Detrex's John Mann. In a sense the last cannot replace ground speed would be set in.

Detrex will not disclose the means used to measure airplane during speed take off run, except to say that it contains ground speed. Airplane acceleration is obtained by differentiating the speed signal, using a resistor-capacitor network. Correction is provided to automatically compensate for slight changes in airplane acceleration as it picks up speed.

Cockpit indicator is a "gal" "magn" type indicator with a pointer that shows how actual versus acceleration compare with value required for take off. Automatic shut pointers is optional.

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• **Transmission in Tubes**—Milwaukee machine produced 17 tubes in a series of testing tubes in its old transmission during for five months of 1955, total factor price of the tubes was less than four times that of total transmission, reflecting the latter's higher cost. Average price for the 174,000,000 tubes is \$7 cents compared to 55.55 average cost price for the 5.9 million transmission.

• **Compensators for Space**—New Compensator for Space Age will be the theme of the 1959 Electronic Compensator Conference to be held May 6-8 at Research Triangle Hotel in Philadelphia. Topics are being sought on each subject in compensators and their application in space vehicles, microcircuits, transistors and the new Mono-Module component. Participating authors should submit 150-200 word abstracts by Oct. 1 to Brig. Gen. Edwin R. Pomeroy, AFCEP Secretariat, University of Pennsylvania 230 S. 35th St., Philadelphia 4, Pa.

• **New Semiconductor Standard**—Proposed new military specification on semiconductor devices, MIL-S-19500B prepared by Armed Services Electronics Standards Agency (ASPSA) has been submitted to industry for comments.



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EQUIPMENT



TETHER ground control station unit is connected to cable (left); black box at cockpit (right) has two pick-off systems.

Tethered Helicopter Under Evaluation

Stuttsford, Conn.—Evaluation of an electronic device which allows a man on the ground to lead a flying helicopter by a 10-ft. tether will be conducted by the U. S. Marine Corps on HUS-1, utility version of Sikorski S-55.

Tether system, developed by Sikorski Division of United Aircraft Corp., previously was evaluated by U. S. Army Aviation School at Fort Rucker, Ala., using an H-34 helicopter. Army may order two tethers for research. Another system involving remote control and a tether has been developed by Kaman Aircraft Corp.

The equipment takes over complete control of an airborne helicopter from the pilot. Aircraft responds to forward and motion in a circle (or tether) hanging down from the side of the cabin. The helicopter will change altitude or position at first and at accuracy, at the ground operator's signals under tapes.

• And in looking up leads to be carried on helicopter's cargo drag, main pilot's vision capability is restricted to downward view. Ground operator can guide aircraft to the lead, maintain constant altitude while another man loads up the drag.

• Low visibility operations, such as blacked-out combat operations or landings in dark or snow areas where helicopter rotor blades cause ground disturbance. Sikorski also says the tether system is suitable on shipboard helicopters during ice stage conditions.

• Ground operator does not have to



GROUND operator manovers helicopter with cable attached to control unit (above door)



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be a pilot. Engineers claim wing-mounted arms can be taught to operate the system in a matter of two hours.

Yeharz will handle aerial crane operations, such as lowering high tension power line towers, transport bridges or placing utility poles.

Senior pilots Sidney Antonette Strickland (ASST) and a senior pilot, usually an electronics training device.

The pilot hangs his aircraft to lower portions at about 70 ft. altitude, then it with ASST, engages the coupler and lowers the cable to ground operator.

In an emergency, the pilot can override the automatic control.

One end of the letter is connected to a strong net attached to the main load meant located in the right side of the cable above the crane arm.

When the pilot engages the coupler, two lights on the bottom of the strong device go on, informing ground once the cable is activated. Move most of the letter is detected by sensing device which then sends signals to the complex Computer, in turn, transmits signals to the ASST system.

Los Angeles-Packaged environmental testing laboratory designed by Munster, Inc., El Segundo, Calif. has been delivered to Rutgers Electronics, Glendale, Calif. Packager includes a humidity temperature test chamber with a built-in electromechanical vibrator, a combination high-low temperature and altitude test chamber, a shock test machine, and two high low temperature test chambers. All chambers are the same height, have the same front and are approximately the same length and depth. All test areas are approximately 7 sq. ft. Mounted on casters, the chambers can readily be arranged in a closed order indicated by a portable testing rack.

Temperature humidity vibration test has an automatic programmer which can be set to provide various environmental combinations and sequences. Programmer will automatically repeat test cycles at intervals as required. Aetco's recording equipment is provided. Altitude-temperature chamber and the two temperature chambers have rate changeable "plug-in" type specimen mounting racks, so that specimens can be moved from one test to another without delay. Spare parts are provided for mounting new specimens. While previous ones are tested.

Altitude phases of the altitude temperature chamber can be raised and opened separately in use of the other temperature chambers.

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Valve is designed for use with helium and R-4 fuel vapor in an atmosphere of inhibited red fuming nitric acid. Solenoid operated shut off valve is leak-proof and operates at a maximum of 1 amp and 28 volts d.c. Contacts are gold plated, conc. packing and lubricant are selected with consideration of the no vaporizer and fluids to be contacted.

Rensell Engineering Corp., 9913 Rosecroft St., Los Angeles, Calif.

Integrated Sequence Control

Sequence control is designed to perform hydraulic, pneumatic and electrical sequencing of solenoid operable functions on-board in the operation of missile engines.

Employed in this control is a multi-

function actuator, timer, combination pneumatic and fuel sequencing valve, electric sequence timer, and a pneumatic actuator. Control is a single unit and can be located on missile engine. Baskin Products Division, South Bend, Ind.

Jet Engine Trimmer

Jet engine fuel trimmer system permits one man in cockpit of aircraft to adjust jet engine fuel controls. Job trimmer requires two to three men. Solenoid actuated system actuation clamped to engine fuel controls and op-



rated by man in cockpit who is able to monitor engine instruments. Trimmer is designed for Pratt & Whitney J57 and J75 engines. Cost of unit is approximately \$1,500.

Leas, Inc., Grand Rapids, Mich.

Bell Valve for Fluids

Pneumatically operated bell type valve is used to be suitable of fluids, ranging in viscosity a 3 in. line in 2 inches, working against liquid or gas pressure up to 2,000 psi at temperatures up to 250°F. Applications suggested include missile fueling systems, aircraft engine fueling and fire extinguisher systems.



Valve retains a high pressure as accumulator controlled by an integral explosion proof solenoid valve. Low pressure current sets off the solenoid, allowing the air to a cylinder piston which moves the valve. Shutoff, return up stream. Four solenoid valve permits recharging of the accumulator and is cooling of the actuating cylinder.

Hefron, Inc., 70 Oliver Park, Los Angeles, Calif.



Late and Scavenge Pump

Pump, designed for modern type engines, has four late elements, three scavenge elements and one pump. 72 gpm at 75 psi with MIL-L-7800 oil at 2,000 rpm surface speed.

Model P504 pump has a ductile iron housing and medium gear component housing, permitting operation in temperature range from -65 to +100°F. Rotating face and prevents leakage between the late and scavenge sections and each late element has a discharge check valve to prevent leakage greater than 1,200 cc in 72 hr. inoperative state.

Leas, Inc., Grand Rapids, Mich.



Adjustable Handling Unit

Model multi-force is designed to accommodate a variety of component parts of fire trucks, jet engines and missiles. Unit fits all sizes, shapes and weights for which special features had

to be constructed in the past, the manufacturer states.

Model Force 1500 adjusts in a few minutes and locks into position around component. Good handling and is used to increase the displacement factor in simple purpose parts of equipment.

Associated Suppliers Co., 2425 San Fernando Rd., Los Angeles 65, Calif.

WHAT'S NEW

Publications Received:

Space Flight by Carole C. Adams. President, National Research and Development Corp. Atlanta. Coauthored by McCullough Book Co., Inc., 110 W. 12nd Street, New York 36, N. Y. \$6.90, 1969.

A survey of the past, present and future of space travel within a way that should prove interesting and informative to general as well as to technical readers. It discusses all important recent advances and provides the reader with details on attentional projects.

Basic Aeronautical Science and Principles of Flight by Robert D. Blevins. Published by American Technical Society, 375 East 58th Street, Chicago 37, Ill. \$5.95, 240 pp.

The purpose of this book is to supply a background in aeronautics for those having no interest in aviation whether business or personal. It is one to understand, book contains historical evolution of the fundamental laws of the physical sciences which are necessary to know how in aeronautics and the principles of flight.

Atlas of the Sky by Vincent de Caluso. Published by St. Martin's Press Inc., 183 Park Avenue, New York 17, N. Y. \$12.50, 157 pp.

This book would interest non-astronomers. It has explicit drawings of the different planets, and contains a listing of the constellations by planet.

Guid Hoppers by Gordon Vachon. Published by Harper & Row, 49 East 33 Street, New York 16, N. Y. \$4.00, 134 pp.

The biography of the Zepelins and of its commander Dr. Hugo Eckener, and also the important part both played in history.

Spacepower by Donald Cox and Michael Stokols, published by The John C. Winston Co., 1010 Arch Street, Philadelphia 7, Pa. \$4.95, 262 pp.

This book analyzes the social, military and legal aspects of space penetration, probing the human mind, needs, hopes and problems in the futuristic new world seen as building for himself.

ENGINEER OPPORTUNITIES AT RAYTHEON



Supplies navigation equipment is needed for flight before order operational conditions. Engineers at the Maynard Laboratory help design today for program from initial study phase through prototype production.

Newly formed project groups solve complex airborne radar problems

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For complete details on engineering positions in any of Maynard's project groups, please write John A. Oliver, P.O. Box 87 A, Raytheon Maynard Laboratory, Maynard, Mass.

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LETTERS

Polar Orbits

In your March 17 issue, p. 21, there is a column titled "The placing of scientific satellites in polar orbits makes radar observations of the Earth from the poles possible." It is not true that Cape Canaveral Fla. is not a polar launching point from which to launch orbiting instruments or even the place of the eclipse and that Russia possesses a launching point suitable for other launch is not a place periodically in that of the eclipse. But it does not necessarily follow that Ft. Meigs ought to be considered suitable as well for polar orbits. Depending on the orbital inclination of the orbit, Ft. Meigs possesses, in some instances, good means of launching its satellite launchings as does that of Omeceen, South Australia.

The ideal university's rapidly launching project would be where the earth's axis of rotation passes through the lithosphere on two points, on the Atlantic continent but a more practical and immediately accessible location is available at Port Pym on Stewart Island in New Zealand. The ring aspect could be along the median between Campbell and Auckland Islands, southwards over the Bellin, Cookson, Foulie and Ross Islands.

What better games could the United States study the advancement of science due to launch a series of interplanetary radio satellite? Don Stewart, Miami-by-appointment with Vice President—among nations such as the Tiers, Vanguard, Atlas and Jupiter, it being desirable that U.S. activities be prolonged into the 1960's as first necessary and because the choice of colors from earth's record is already underway.

Such property has the works on the design and control of hyperbolic gradient fuel spray nozzles are not present in Australia. It is, in fact, wholly new to engineers in South America and needs effort to do so.

WILLIAM H. FRYER
London House
Kew-Falk, Sydney, N. S. W.
Australia

[illegible]

Group Air Travel

I read with considerable interest the article "Transboundary Climate Change Factors" (JAW June 1, p. 25). It is a solid argument that this type of operation can have a fairly important long range benefit to transnational action since group based or larger entities will not only tap a new segment of the market but also tend to develop broad based trading income groups which should not only sell, surely transnational business

To convert the group travel into a support customer and then a potential client for the scheduled services, he first expressed an interest in long-range travel details, of course, by e-mail. My intention, if the service provided on such flights—and I am not in-

Arcturion Week welcomes the opinions of its readers on the issues raised in its magazine's editorial columns. Address letters to the Editor: *Arcturion Week*, 220 W. 42nd St., New York 36 N. Y. To receive letters under 500 words and get a genuine identity stamp. It's not just print names; more letters that concern us will be withheld no reason.

harm to the amount of bread showing on their sandwiches—a point the customer is not too likely to upset the experiment, either by charities or scheduled flight; and that would be deplorable since it seems there are going to be an awful lot of tests to fill when the new pits go into service.

The following is an example of how good (and should not be confused, not even at bargain rates) The store is here, but the names have been changed to protect the subjects.

John Smith works for a large company with a very good industrial relations department. These months ago he learned that an industrial group of which his own firm is a member was organizing a tour of Europe. This sounds interesting, partly because the "Millennium's Variator" will last 35 days and transatlantic transportation will be provided by a first class aircraft chartered from a well-known school of error.

John Nough counts his change: signs up and schemes in profit anticipation

One week before departure, Dr. John Smith is requested to quit. Thus he knows that some course changes have been made. Nothing important, Smith thinks. They are not going to be with the airline that are going with, contemplated but with a new airline now scheduled outfit. The first class accommodations are provided by a great DC-6A, among some 30-odd passengers. And that, he is going to leave in the latter this intended *Servicio* number of *Servicio* from parading John with a full crew, to do his shopping. One brief week, Smith thinks that the DC-6A, now engaged, a large plane and the seating appears a little cramped.

As time goes on he insists that the plane will not leave until Sunday evening, and will take some 10 hours to get from New England to Frankfurt, that it will be his last another day of his previous vacation here. Ten days before departure he is informed that the flight has not been approved by the CAA and must be cancelled. The travel agency arranging the flight, the national group director, and several other people learn about the difficulty. For some, two weeks before this, let John go to their birth, about 100 km from the border in a region — but his fate has been shattered and it is

While John Smith Smith leaves the CIA, he has selected he is naturally reflective but he still keeps wondering if he should have signed up at all. Perhaps the notion is not as viable as he was told. If that's the first steps trip as a publicist is he seen off by a little frightened. Not all posters really sitting in good faith? He has the feeling, however, that not only really cases if he has enough time in Europe that he is more

a statistical figure as perhaps an insignificant number of people in the hands of the industrial agents, and industrial group is not sure he has raised some complaints, on his own part, to the industrial group, and has been patiently given to understand that everyone is doing whatever can be done, that he does not understand what is going on and who must be sorry for his own people.

The final crew does not come until D-day minus two when John Smith is airlifted at 11:30 p.m. and accounts a ride game. You was panned at. The flight is delayed and will now leave on Monday, shortly before noon. It appears he gets a ride home for the evening on his family, no more.

By now our friend has had quite enough. He decides to go it alone by scheduled flight and damn the expense.

The wife and dog are rolled up, coffee is fixed and then they settle down to work hard work. Two hours later they have a beautiful plan. Then will postpone their vacation by one week to over and have 16 glorious days in Europe.

The only problem concerning is the one reflection of these all-aged team John Smith picks up the industrial group and sends his man's truck No day. He explains in full detail what the trap he would be getting

be seen only a slight resemblance to the top
be thought by bought. Since the industrial

group behind the money to the agency, and he cannot get it back. Several of his friends' mothers often push him to bed late, because of constant and some words we shall not repeat here. It seems the contact between the affected group and the moral agency is weak.

Mr. John Smith has no choice but to go along and try to get his money's worth before he is thrown out. He has been told that this trip is worth the cost to him. Mr. Smith quite prominently shows his confidence in his trip to Europe. After all, having a new car is much simpler and less costly than a considerable loss risk.

Rock: What
Hudson: Cries

Formation Landings

What the hell! Has everybody forgotten those pictures of 1925—or, at least 1941—of these people, these *Amos*, *Calvin*, and *Sam*?

Wasn't Carl Spats one of the pilots?
 Nope! No, sorry. P.L.T.'s

Speaker: if you be there all you together and they, land themselves—any that furmize you landing?

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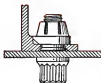
Speedier installation of access panels

ESNA gang channel nut strips eliminate the costly, time consuming installation job of riveting individual nuts. Available in straight or curved sections and even complete rings, custom designed for applications such as access doors or inspection covers.



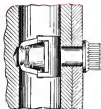
Bolting non-parallel surfaces

No more costly spot facing, step milling or hand selecting tapered shims! ESNA's counterbored, self-aligning types include one lug, two lug, gang channel, standard hex and high tensile types. Ball-and-socket relationship of nut and special base allow an 8° tilt in any direction from centerline to compensate for draft angle or tapered sections.



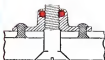
Fastening stressed joints subject to temperatures up to 1300°F.

For really "hot" applications such as jet engine flange assemblies or fire wall sections, where fastener dependability is critical, ESNA offers the "long-beam" locking device. The full cantilever of these sections assures protection against failures related to relaxation, creep and similar problems caused by the effects of extremely high temperatures upon metals. (Ask for ESNA Bulletin No. 5715 Design Manual for High Temperature Self-Locking Nuts.)



Simplifying major substructure joining

An ESNA barrel nut doesn't have to be held for wrenching... doesn't need precisely mated bolt holes. The barrel-shaped fastener is simply finger-pressed into a drilled or reamed hole until the special clip snaps into position at the bolt hole location. The .030" float of the nut section of this fitting avoids misalignment problems and the bathtub recess for wrenching area is eliminated. New NAS 577 barrel nut (180,000 psi) now available. Also 160,000 and new 220,000 psi series.



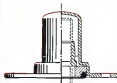
Applications requiring guaranteed high reusability through more than 50 on-off cycles.

Where repeated tear-down and re-assembly or frequent readjustment is required, the exceptional elastic "memory" and non-galling characteristics of ESNA's standard nylon locking insert guarantees long lasting locking torque and fastening dependability. Available in all sizes and configurations of standard aircraft type nuts. Parts can also be designed to order and in any standard configuration, with guaranteed re-use factors as high as 300 on-off cycles.



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